DECISION OF THE ADMINISTRATOR OF THE ENVIRONMENTAL PROTECTION AGENCY REGARDING SUSPENSION OF THE 1975 AUTO EMISSION STANDARDS

PART 1

HEARINGS

BEFORE THE

SUBCOMMITTEE ON AIR AND WATER POLLUTION

OF THE

COMMITTEE ON PUBLIC WORKS UNITED STATES SENATE

NINETY-THIRD CONGRESS

FIRST SESSION

APRIL 16, 17, AND 18, 1973

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APPENDIX

DECISION OF THE ADMINISTRATOR OF THE ENVIRONMENTAL PROTECTION AGENCY REGARDING SUSPENSION OF THE 1975 AUTO EMISSION STANDARDS

MONDAY, APRIL 16, 1973

U.S. SENATE,
COMMITTEE ON PUBLIC WORKS,
SUBCOMMITTEE ON AIR AND WATER POLLUTION,
Washington, D.C.

The subcommittee met at 10 a.m., pursuant to call, in room 4200, Dirksen Office Building, Hon. Edmund S. Muskie (chairman of the subcommittee) presiding.

Present: Senators Muskie, Randolph, Buckley, and Domenici.

OPENING STATEMENT OF HON. EDMUND MUSKIE, U.S. SENATOR FROM THE STATE OF MAINE

Senator MUSKIE. The committee will be in order.

Today's hearing is for the purpose of permitting the Administrator of the Environmental Protection Agency to present formally to this subcommittee his decision regarding suspension of 1975 auto emission standards.

[The decision of the Administrator follows:]

BEFORE THE ADMINISTRATOR

ENVIRONMENTAL PROTECTION AGENCY

Washington, D. C.

In re: APPLICATIONS FOR SUSPENSION OF 1975
MOTOR VEHICLE EXHAUST EMISSION STANDARDS

American Motors Corporation, Chrysler Corporation, Ford Motor Company, General Motors Corporation, and International Harvester Company, Applicants.

DECISION OF THE ADMINISTRATOR ON REMAND FROM THE UNITED STATES COURT OF APPEALS FOR THE DISTRICT OF COLUMBIA CIRCUIT

April 11, 1973

DECISION OF THE ADMINISTRATOR

I. Introduction

Section 202 of the Clean Air Act, 42 U.S.C. 1857f-1, requires that emissions of carbon monoxide and hydrocarbons from automobiles sold in this country during the 1975 model year be reduced by at least ninety percent from their 1970 levels. The only authority which I as Administrator have been given to affect the application of these standards is set forth in Section 202(b)(5) of the Act. That section allows me to suspend the effective date of these reductions for one year only, provided the following conditions are met:

> "The Administrator shall grant such suspension only if he determines that (i) such suspension is essential to the public interest or the public health and welfare of the United States; (ii) all good faith efforts have been made to meet the standards established by this subsection; (iii) the applicant has established that effective control technology, processes, operating methods, or other alternatives are not available or have not been available for a sufficient period of time to achieve compliance prior to the effective date of such standards, and (iv) the study and investigation of the National Academy of Sciences conducted pursuant to subsection (c) and other information available to him has not indicated that technology, processes, or other alternatives are available to meet such standards."

The first application for a suspension under that p[illegible] was filed with EPA on March 13, 1972, by A. B. Volvo Ltd. of Sweden. Shortly thereafter, applications were also received from Chrysler, Ford, General Motors, and Internationa Harvester. After three weeks of public hearings, I denied all five applications in a decision issued May 12, 1972.

The four American applicants appealed this decision to the courts, and on February 10, 1973, the United States Court of Appeals for the District of Columbia Circuit, in a lengthy and detailed opinion, remanded the applications of the four appellants to me for reconsideration. International Harvester Co. v. Ruckelshaus, (Slip Opinion No. 72-1517, February 10, 1973).

Following this remand by the Court, over two weeks of public hearings were held commencing March 12, 1973, to consider both the remanded applications and the application of American Motors Corporation, which was filed on March 2, 1973. In the course of these remand proceedings, a great mass of oral and written material has been furnished, both voluntarily and in response to EPA subpoenas, by the applicants, other auto manufacturers, suppliers of catalysts and catalyst components, oil companies, and representatives of public interest groups.

Substantial testimony was taken both before and after the remand concerning emission and other characteristics of engines different from the conventional internal combustion engine. It remains clear that some alternate engine systems can achieve the reductions required by the Act, and certain alternate engine systems may well constitute preferred technology for the long term. However, no participant in the proceeding seriously contends that basic new car demand in 1975, as defined by the Court, can be met if the industry cannot continue to produce and use conventional internal combustion engines in numbers roughly equivalent to current production of these engines. Because catalysts are generally necessary to control emissions from conventional engines to levels approaching the statutory standards, the principal questions before me on this remand are whether conventional engines equipped with catalysts can meet applicable emission standards and can be produced in 1975 in sufficient numbers to satisfy basic demand in a manner consistent with the public interest.

Without exception, all automobile manufacturers contend that catalyst technology is not presently available and effective to achieve the emission reductions required by the Act. The manufacturers also contend that, even if prototype vehicles for sufficient numbers of models could be certified at the statutory levels in time for 1975 production, severe production problems are likely to occur the first year catalysts are used and will result in recurrent and widespread production stoppages. Chrysler and some other manufacturers further contend that, even if catalyst-equipped vehicles can be successfully certified and mass produced in 1975 without difficulty, a large percentage of these devices will fail in actual customer use, thereby subjecting the manufacturer to extraordinary liabilities under the Act's recall and warranty provisions. Most foreign manufacturers share Chrysler's reluctance to use catalysts on any 1975 models.

Ford and General Motors are decidedly less pessimistic about the effectiveness of presently available catalyst technology. As I understand the positions of these two manufacturers, as developed during these proceedings on remand, they believe that a limited introduction of catalyst-equipped cars in 1975 is feasible and desirable as an initial step toward nationwide use of catalysts on all models. Ford and General Motors have accordingly proposed interim standards for California vehicles which they contend will require the use of catalysts on all California models.

Since the early 1960's the State of California has been the leader in automobile emission control. In general, federal standards have followed California standards by at least one full model year. This historical pattern of regulation has permitted manufacturers to scale up their production processes as improved emission control technology is developed and employed. Initial introduction of new emission control technology in California, followed by nationwide use in a later model year, has been made possible by provisions in the Act for waiver of federal preemption of California requirements for controlling emissions of new vehicles.

Acting under these provisions of the Act, I have waived federal preemption with respect to emission standards prescribed by California for vehicles built and sold during the 1974 model year. While California's 1974 standards for hydrocarbons and carbon monoxide are only marginally more stringent than federal standards applicable to 1974 automobiles, California's 1974 standard for nitrogen oxide emissions is substantially stricter than the federal standard. In addition, under California law 90 percent of production vehicles are required to meet applicable certification standards, a requirement which makes a California certification standard significantly more stringent than an equivalent federal standard. California has requested waiver of federal preemption for a new set of standards applicable to 1975 automobiles which requires a substantial further reduction in emissions of all three pollutants. This request is now pending before me for decision.

The following table compares these various standards and proposals for California and indicates the approximate degree of emissions from uncontrolled automobiles: */

	HC	CO	NOx
	(grams per mile)		
Uncontrolled cars	8.7	87	3.5
Fed. 1974 standards	3.0	28.0	3.1
California 1974 standards	2.8	28.0	2.0
Proposed Ford standards	1.2	17.0	2.0
Proposed Calif. 1975 stds.	.9	17.0	1.5
Statutory 1975 Standards	.41	3.4	(3.1)

Bearing in mind the additional stringency created by the California requirement that 90 percent of production vehicles meet the certification standard and by the requirement that California vehicles control nitrogen oxide emissions to levels substantially below federal standards, the proposed California 1975 standard for hydrocarbons of .9 grams per mile approaches in stringency the Congressionally mandated standard which these applicants seek to have suspended.

The National Academy of Sciences has prepared and submitted three reports that are pertinent to this matter. The first two reports, issued in January and April of 1972, respectively, predated my earlier decision. The third report, dated February 15, 1973, was submitted five days after the Court issued its opinion and order remanding the proceeding to me.

In remanding this matter to me for reconsideration, the Court of Appeals weighed the "grave economic consequences" that might result from denial of a suspension against the environmental costs that might result from granting of a suspension. The Court concluded that "the risk of an 'erroneous' denial of suspension outweigh[s] the risk of an 'erroneous' grant of suspension," even if no interim standard for

*/ General Motors' proposed California standards for the three pollutants are .76, 5.7 and 3.1, respectively. However, General Motors has premised this proposal on a significant relaxation of the federal certification procedure. Hence, it is difficult to compare the General Motors' proposal with other proposals. (Footnote continued)

1975 is prescribed. As I read the Court's opinion, the Court believes that these risk-balancing considerations should be taken into account in determining whether effective control technology will be available in 1975. On that basis, the Court has required a high degree of confidence that 1975 standards can be achieved and has cautioned that a decision to deny suspension, to the extent it is based on predictions of technological availability as opposed to direct evidence of such availability, must be supported by a detailed showing that the methodology underlying the prediction is reasonable and reliable.

The Court's discussion of factors pertinent to this decision includes a broad range of "public interest" considerations, including "the impact on jobs and the economy" from any decision resulting in decreased levels of production during 1975. In my view, the Court's opinion correctly emphasizes that my decision should be designed to bring about ultimate achievement of the statutory standards by 1976. The Court has also emphasized that the statutory authority to suspend the standards and to set interim standards during 1975 should be used as a "safety valve" to minimize the risk of serious economic consequences when the necessary technology is first introduced.

II. Summary of Decision

As I view this decision, the issue before me is essentially the most reasonable method by which necessary technology will be installed on automobiles to meet the statutory standards. In resolving this issue, on this record, I believe that I have three basic choices.

First, by denying these applications or by establishing national interim standards similar to those proposed for 1975 by California, I can in effect require the automobile industry to install catalytic converters on all conventional 1975 automobiles. Second, by establishing interim standards which do not require use of catalysts, I can allow the industry an additional year to further test and improve catalyst or other technology, while requiring substantial additional reductions

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(footnote continued)

All standards for HC and CO are expressed in terms of the 1975 Federal CVS test procedure. The 1975 federal NOx standard has been prescribed pursuant to Section 202(a) of the Act.

in emissions through engine modifications. Third, I can require use of catalysts on a substantial portion of 1975 vehicles, thereby attempting to minimize initial production problems and their potential impact on the public while requiring each manufacturer to gain production experience preliminary to use of catalysts on all conventional engines during the 1976 model year.

It is my judgment that the third option best serves the total public interest and the mandate of the statute. It promotes continued momentum toward installation of control systems meeting the statutory standards, while minimizing risks incident to national introduction of a new technology. This option also offers the opportunity to gain experience with production of catalyst systems for a full range of automobiles by requiring catalysts on a portion of each model introduced by each manufacturer in the State of California.

I am accordingly waiving federal preemption for California's 1975 hydrocarbon standard of .9 grams per mile (as measured on the 1975 federal test procedure), except to the extent that such California standard applies to multipurpose vehicles as later defined in this decision. I am also waiving federal preemption for continued application during the 1975 model year of California's nitrogen oxide emission standard of 2.0 grams per mile (as measured on the 1975 federal test procedure), except to the extent that such California standard applies to multipurpose vehicles. This waiver of federal preemption shall include California's assembly-line test requirement. In order to insure that catalysts are used in California, I am denying waiver of preemption for California's 1975 carbon monoxide standard and I am prescribing a more stringent federal interim standard for 1975 light duty vehicles shipped to California, other than multipurpose vehicles, limiting emissions of carbon monoxide to 9.0 grams per mile, as measured by the 1975 federal test procedure.

Thus, under my decision the federal and State standards applicable to 1975 cars sold in California will be: .9 grams per mile of hydrocarbons; 9.0 grams per mile of carbon monoxide; and 2.0 grams per mile of nitrogen oxides. These standards in my judgment will require use of catalytic converters on all 1975 passenger cars shipped to California. California sales of such vehicles constitute approximately ten percent of total United States new car sales.

Except to the extent that a vehicle is subject to a more stringent carbon monoxide standard applicable to vehicles shipped to California, all 1975 light duty vehicles, other than multipurpose vehicles, shall be subject to the following federal interim standards, as measured by the 1975 federal test procedure: 1.5 grams per mile hydrocarbons; 15 grams per mile carbon monoxide; 3.1 grams per mile nitrogen oxides. These standards can, in my judgment, be achieved by manufacturers generally on most models without use of catalytic devices. In my judgment these standards will not require use of catalysts on more vehicles sold outside California than manufacturers are capable of producing without the possibility of severe production difficulties.

Multipurpose vehicles shipped and sold during the model year 1975 shall for the most part be subject to emission standards applicable to 1975 light trucks.

The most compelling factor in my decision to require phase-in of catalysts in 1975 has been the possibility raised by the evidence that if the automobile industry attempts to install catalytic converters on its entire product line, without a scale-up period of limited mass production in which to gain experience, difficulties such as a shortage of vital parts or materials, inaccurate machining tolerances, or defects in assembly techniques will arise, and may well be severe enough to cause significant economic disruption. These problems will be more fully discussed later in this decision. I believe that the requirement to install catalytic converters on all 1975 automobiles shipped to California and on a portion of 1975 cars sold outside California will minimize adverse economic effects which could be caused by production difficulties associated with initial use of new technology, will require all manufacturers to gain experience in the mass production of catalyst-equipped cars under conditions of careful quality control, and will maintain the accelerating momentum of technological progress which has so clearly characterized catalyst development for automotive applications during the past two years. In requiring a limited introduction of catalysts in 1975 I am holding the two major United States manufacturers to their commitments to use the additional year to gain essential experience in production techniques by equipping all California models with catalytic converters.

My decision will have other important effects.

New 1975 cars sold in the Los Angeles basin, where automobile-related pollution is most severe, will have the highest degree of emission control that is technically achievable in 1975 on a broad range of cars. In addition, two Japanese manufacturers (Toyo Kogyo and Honda) plan to market significant numbers of automobiles powered by innovative engine systems which do not require catalytic treatment to achieve emission reductions even lower than appears to be possible with conventional engines. These companies sell a disproportionately high number of their vehicles in California. Hence, the advantages which these alternate engine systems may offer, in emission control and in other areas of performance, will have an early test in the marketplace. Where regulatory requirements for emission control challenge conventional technology to its limits, the marketplace will in my judgment provide a strong lever for causing a shift into any superior technology.

The selection of California for initial introduction of catalytic converters has other advantages as well. Because of California's history of leadership in emission control, that State has in existence a legal and regulatory framework for implementing and enforcing a set of standards different from those applicable outside California. Because of its size, and because its major cities are geographically distant from other States, regulation of out-of-State traffic is less essential, and enforcement of requirements applicable to California residents is less difficult.

At the same time, I believe that the national interim standards I am prescribing will obviate or minimize the need for additional transportation controls in urban areas outside of California. These interim standards, while they are achievable for the most part without catalysts, require a reduction in emissions from uncontrolled levels of over 80 percent and a reduction from 1974 levels of about 50 percent. To the extent that additional transportation controls are needed outside California, vehicles designed for California can be purchased in 1975 by fleet operators, such as taxicab companies. Although evidence was presented that failure to deny suspension would adversely affect the attainment of ambient air quality in some areas, notably New York City, this evidence was based on a continuation of the 1974 automobile emission standards. The national interim standards which I am establishing will not, in my judgment, unduly inhibit control programs in urban areas outside California.

III. Discussion

1. Encouraging Progress in Development of Technology

In my decision of May 12, 1972, I found that, although no manufacturer had yet succeeded in running a car that met the 1975 standards for the required 50,000 miles, promising new technology was available to the manufacturers which, in view of the time that then still remained for development and testing, made it reasonable to conclude that compliance could be achieved within the statutory deadline. May Dec. pp. 8, 13.*/ It is clear that during the 11 months since last year's decision impressive strides of progress have been made by some companies toward development of technology capable of meeting the 1975 emission control standards at reasonable cost, even though the constraints of time appear to make it not feasible to apply those standards for 1975 model year cars.

The evidence available indicates that questions previously raised as to whether use of catalysts might create safety hazards can now be largely set aside. It also appears that the cost of emission control systems will be less than previously anticipated. Finally, concerns over the fuel penalty which might result from use of catalysts have been reduced significantly.

Certain data presented by General Motors provides considerable support for optimism that the industry is on the brink of success in meeting the 1975 standards. Six cars from GM's latest test fleet have completed the 50,000 mile test runs which the law requires. Three of these met the standards at the end. GM App. VI-11. Two more almost met

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*/ In this Decision, the following abbreviated citations are used:

Tr. - The transcript of the March 1973 hearings.
May Dec. - My prior decision of May 12, 1972.
Dec. - The slip opinion issued by the Court of Appeals on February 10, 1973.
C. App. - The Supplemental Statement of Chrysler Corporation dated March, 1973.
F. App. - The Submission Upon Remand of Ford Motor Company dated March 5, 1973.
GM App. - The Statement of General Motors Corporation on Remand dated March 5, 1973.

(Footnote continued)

the standards. This fleet was built and started running almost a year ago. Given the rate of progress in this field, it is reasonable to expect that its performance would be significantly better today. As Mr. Starkman of GM testified, "We are on a very steep learning curve." Tr. 2990.

Test data on durability cars run by other auto manufacturers for 50,000 miles also show a number of other examples where systems have achieved compliance with the 1975 standards or have come very close to doing so. Results for cars driven substantial mileage (for example, in the range of 20,000/ 30,000 miles) contain a sizable number of other cases where the 1975 Federal standards were being met. It must be recognized that other test cars have performed unfavorably and produced data considerably above the 1975 standards. In many of these latter cases the poor results are attributable to identifiable and correctable problems; in other cases, however, it is unclear whether such an explanation applies. It is also apparent from other data submitted on the basis of dynamometer and laboratory testing that significant improvements in catalysts have been made, making it reasonable to assume that future test results will be better than past test results. Tr. 917; 1322-24; 1356-60; 1423-25; 1496. On balance, I believe that an overall review of test data supports the judgment that solutions are close at hand to overcome any remaining obstacles which might interfere with achievement of the 1975 standards by the auto manufacturers.

The applicants contend that their test results show that, if catalysts are installed on all cars in 1975, a high proportion can be expected to fail in customer use. Indeed, this expectation of catalyst failure constitutes one of the principal arguments that technology is not "available" to

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(footnote continued)

NAS Rept. - the Report by the Committee on Motor Vehicle Emissions of the National Academy of Sciences dated February 12, 1973.

Ford Mem. - The Post-Hearing Memorandum of Ford Motor Company.

C. Mem. - The Post-Hearing Memorandum of Chrysler Corporation dated March, 1973.

C. Doc., Vols. I-VI - The six volumes of documents submitted by Chrysler Corporation in response to Mr. Allen's requests made on March 15 and 21, 1973, and set forth at Tr. 1143 and 2355-57.

EPR Minutes - Minutes of the Emissions Policy and Review Committee of Chrysler. These are contained in C. Doc., Vol. II and are cited by date.

meet the 1975 standards. The applicants further argue that ruinous legal liabilities could be imposed on them under provisions of the Clean Air Act that force the manufacturer to warrant the catalyst and provide for the recall of models of vehicles when a significant number are found to exceed standards. Some have also sought to raise a fear that the catalyst will pose a danger to the vehicle and its occupants.

Such arguments deserve careful consideration.

It is clear to begin with that a catalyst "failure" will neither harm the driver nor damage the vehicle. The term is used to describe a situation in which the catalyst for some reason deteriorates and therefore fails to burn the pollutants passing through it. The catalyst then sits inert on the tail pipe of a vehicle which performs in all other respects exactly the same way it did before.

Ford, when questioned on this point, said that the danger it feared from the nationwide installation of catalysts was simply that they would not control pollution as they should, and that Ford Motor Company would be exposed to legal liability in consequence. Tr. 2191-93. General Motors was even more emphatic. Tr. 2431-2437. Similarly, the National Academy of Sciences testified that in expressing reservations about the use of catalysts it did not mean in any way to imply that vehicles in which the catalyst failed would not be safe and would not operate properly. Tr. 1605-06.

The only form of catalyst failure that any manufacturer suggested might be dangerous was melting. This can occur when the catalyst is supplied with an overdose of unburned hydrocarbons or carbon monoxide (caused, for example, by a failed spark plug) which overheats the catalyst due to higher temperature of combustion going on inside it. However, the only manufacturer of catalyst containers who testified stated that his company was willing to warrant that any such melting failure would not burn through the outside can if his company had supplied it, and that the outside of the can would not even get dangerously hot. Tr. 1541, 1550-51 (Walker Manufacturing Co.) Similarly, Ford testified that their catalyst containers had an adequate margin of safety against such failures. Tr. 286-87.

In my view such a record is clearly enough to outweigh a few recitals of testing mishaps, Tr. 384, 875, an asserted

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lack of sufficient knowledge by American Motors, Tr. 2363-64, and the perpetual fears of Chrysler. Tr. 2289-93. (Chrysler's expressed fears are contradicted by its own submission, which states: "When ['catastrophic failure'] occurs, there is no indication to the driver of the failure, except that in some cases the vehicle actually drives better and fuel economy may improve." C. App. p. I-34.)

It is difficult if not impossible to determine now what frequency of catalyst failure should be anticipated when catalysts are put into mass production and installed on cars for regular use. A substantial incidence of catalyst "failure" has been experienced by auto manufacturers in various testing programs. Claimed failure rates in the range of 10 to 20 percent have been made and Chrysler says it experienced failure rates "up to 40 percent."

In many cases, however, it appears that the auto companies have attempted to represent any physical damage to the catalyst as a "failure." In fact, a comparison of five melted or cracked catalysts from Riverside West (all claimed as "failures" by Ford, see F. App. Table 4-6) with fourteen unfailed catalysts that is made in the "Failure Analysis" section of the Technical Appendix indicates that the physical damage had no statistically significant effect on catalytic activity.

Chrysler data was not sufficient for such a comparison. It may be noted, however, that the dramatically "failed" catalyst portrayed in C. App. Appendix G. pp. 19-20 was tested after the extensive melting depicted had occurred and found to have conversion efficiencies of 70% for HC and 90% for CO.

The Technical Appendix also gives a detailed breakdown of the number of emissions failures due to engine malfunctions of a type that can be expected not to occur in production cars, and of the number of catalytic failures that appear to have been cured by technical advances (for example the "clamshell" mounting Chrysler has developed) or to have resulted from failure to use the most advanced system (for example, the lack of heat resistant ignition wires in Ford's Riverside West program).

It appears that the test cycles on which Chrysler ran catalysts are designed to overstress engine components so they will show their weak points quickly, and that in the past vehicles run on these cycles have had component failure rates about ten times higher than in the field. Tr. 368, 418-19, 229, 2301, 2306-07. Many of these failures, moreover, have been associated with engine malfunctions of a type which the manufacturers generally admit will not occur often in normal use. Tr. 76-77, 416. See also Tr. 2959. Future experience with catalyst failure is also likely to be reduced as a result of improvements in heat resistance properties of catalysts, and progress in developing overtemperature protection devices. Consequently, it now appears probable that the overall effectiveness of catalysts installed in production vehicles will be reduced only within relatively narrow limits as a result of catalyst failure.

Overall, catalysts are highly effective pollution-control devices. Even a mediocre catalyst can be expected to destroy 80 percent of the carbon monoxide and about 50 percent of the hydrocarbons that pass through it.

Nor do the costs for the degree of emission control appear excessive. According to estimates in the 1973 NAS Report, with which my staff generally agrees, a 1975 model catalyst equipped car can be expected to cost about $160 more than the emission control system on a 1973 model. About $57 of this cost will be accounted for by the catalyst. NAS Report Table 5.2, pps. 90-93. Although additional costs to the consumer will result from the need to use unleaded fuel to avoid catalyst poisoning, unleaded fuel also is expected to create savings in maintenance costs which will be approximately equal to the costs resulting from removal of lead from fuel.

In summary, the development of technology to date, as reflected in the testimony and documents presented in these proceedings, holds promise for meeting the 1975 standards. In particular, catalyst devices now clearly appear to be effective, durable and reasonably inexpensive.

2. Evaluation of Whether Technology is Available to Meet the 1975 Standards.

The initial question raised by these applications is whether "effective" control technology is "available" to achieve compliance with the Federal 1975 standards with respect to 1975 model year vehicles. As previously indicated, a positive determination of this question must rest upon three separate subsidiary findings, namely:

(a) Enough models of vehicles to meet the 1975 "basic demand" for cars must be certified prior to commencement of production;

(b) It must be feasible to mass produce these cars in sufficient quantity to meet that demand; and

(c) The emissions control systems on these cars must function acceptably in actual use by customers.

(a) Certification

The first question is whether technology has been developed to the point that manufacturers can meet requirements for certification of their 1975 models if tested by the 1975 standards. The certification procedures are based upon tests of prototype and preproduction vehicles. Therefore, examination of the probabilities for certification does not include consideration of any of the problems of mass production. What it does focus upon is the capability of a manufacturer to build a limited number of cars for each model line that it intends to sell which can meet the applicable standards. Since all of the test data is derived from cars which are in essence individually equipped prototypes, the test data bears directly upon this question. Because of the preliminary state of development a year ago, the question of certification was virtually the sole issue seriously discussed at the public hearings last spring.

The methodology used for analysis of test data submitted in these proceedings is discussed in greater detail below. My examination of the fundamental technical issue whether technology is adequate to make it feasible for auto manufacturers to meet the 1975 standards has included extensive analysis of test data utilizing this methodology. It has also included a review of the raw data to evaluate the significance that may properly be attached to test results without making adjustments as required by a system of methodology. It has also included a general review of the overall status of development as reflected in the evaluation of the NAS Report and testimony and other statements of persons having expertise in this field.

On the basis of my examination I find it extremely difficult to predict that enough models of vehicles to meet the 1975 "basic demand" for cars could be certified under the 1975 standards. I find that the 1975 standards can be met by technology utilizing a rotary engine, a stratified charge engine or a light-duty diesel engine. It is clear, however, that a shift over to such technology cannot be accomplished within time to meet more than a fraction of the 1975 basic demand. With respect to conventional internal combustion engines, I find that technology has developed to the point that many models (66 percent of sales) almost certainly would meet certification requirements under the 1975 standards. It is less certain that other models would be able to meet those requirements.

As indicated previously, the Court of Appeals in its decision has directed me to weigh the evidence and make my decision "by taking into account that the risk of an 'erroneous' denial of suspension outweigh[s] the risk of an 'erroneous' grant of suspension," Dec. p. 58. It cautioned me against holding the "safety valve" of suspension "too rigidly," Dec. p. 44, and advised me that these risk-balancing considerations, though they may seem to speak only to the "public interest test," must also be taken into account in determining whether technology is available, Dec. p. 47.

Weighing all of these considerations, I believe that presently available technology is probably effective to achieve compliance with the 1975 standards insofar as the certification requirements are concerned. However, I also believe that there is a significant risk that this determination would prove to be erroneous and that manufacturers would not be able to successfully certify vehicles at the statutory levels in sufficient numbers to meet basic demand for 1975 cars, either in California or throughout the Nation. My decision requiring California cars to meet slightly less stringent standards minimizes these risks without any significant adverse effect on air quality in California and assures that a full line of 1975 cars with catalysts will be certified for California. I believe this decision is in the public interest and is fully consistent with the Court's opinion.

(b) Production

The second basic issue pertinent to my decision in this case is whether it is feasible to produce cars utilizing the best available technology, which in the case of conventional internal combustion engines includes use of catalysts, on a mass production basis in sufficient quantity to meet the 1975 basic demand.

At least ten million automobiles are expected to be produced and sold in this country during the 1975 model year. If Federal emissions standards in that year require the use of catalysts on all conventional engines, somewhat more than ten million catalysts will have to be produced and the automobile assembly lines will have to be adapted to provide for catalyst installation.

At present neither the auto industry nor the catalyst industry has any significant experience with the mass production or handling of the type of catalysts that will be required. Furthermore, the evidence before me indicates that the auto industry has drastically abbreviated many of its normal procedures in order to stand ready to put catalysts on all 1975 vehicles. Construction and tool-up commitments have been made while the final design of the component that will be produced in these facilities is still under development. The normal procedure of phasing in new technology across a portion of the model line, which allows major unforeseen problems to be discovered and dealt with, has been dropped. Even the normal shake-down time used to correct minor defects in new assembly lines has been greatly abbreviated.

The elimination of these procedures has allowed the industry to preserve capacity to put catalysts on all its 1975 cars. By that I mean that the applicants have made all the necessary long-term commitments for plant construction, tool-up, release of designs, and the like, which have had to be made up to now, and have thus been able to adhere to a schedule which, if all went well, would allow sufficient numbers of catalysts to be produced and installed.

There remains, however, the possibility that all may not go well. The company which has laid the most stress on this point is General Motors.

In its opening statement, GM testified that it had drastically compressed "the normal procedures for procuring and testing machinery," and had pushed its manufacturing plans "in parallel with the development program." They added, "Since neither component development nor process development will have had the benefit of the usual testing procedure, our experience tells us serious unforeseen production problems are very probable." Tr. 24; see also Tr. 29.

GM reiterated these points in subsequent testimony, Tr. 129-30, 222-23, which included a detailed description of the complexities of starting a new production line, Tr. 159-62, 166-68. Although GM's main emphasis was quite frankly on unknown problems that their business judgment told them were to be anticipated, the witnesses presented both specific examples of areas where problems might arise, Tr. 162, 171-72, 222-23, 2450-51, and a paper outlining instances where this had happened in the past, Tr. 2395-98, 2429-30, 2453-54.

Ford also made these points. F. App. pp. 4-50, 4-53, 4-62, Tr. 284, 2195-96. However, they laid relatively more stress on problems in producing the catalysts themselves.*/ F. App. pp. 4-28-32; Tr. 263-65. Ford claims that "failure mode analysis" which it has carried out on the catalyst production process shows there are two to three times as many ways for that process to fail as is the case for other new components. Tr. p. 265; see F. App. pp. 4-29-30.

American Motors also raised the possibility of production difficulties. Tr. 2367-68.

If the only statements forecasting such problems came from auto manufacturers, I might well discount that testimony, for the applicants for extensions have an obvious interest in painting a dark picture of what will happen if catalysts are required nationwide 15 months from now.

One manufacturer of catalyst components, however, echoed these fears in the strongest terms. Tr. 1544-48, 1552-53, 1558, 1565-66 (Walker Manufacturing Company). Another testified less emphatically, but to the same effect. Tr. 1421-22, 1429-30, (W. R. Grace & Co.). The remaining four manufacturers were more optimistic about their own capacities, but none disputed the auto companies' statement that there might well be problems with the process as a whole. Tr. 1449, 1462 (American Lava Corporation); 1507-1510 (Corning Glass Works); 918-19 (Engelhard Industries); 1312 (Matthey-Bishop, Inc.);

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*/ This may be because the task of quality control is more difficult for a monolithic catalyst (which Ford proposes to use) than for the pebble catalyst GM has chosen. Tr. 1396-97.

1381-82, 1390-92, 1396 (Universal Oil Products Company). Since it was against the financial interest of the catalyst companies to give testimony that might lead to delaying the nationwide use of catalysts by a year, this evidence has had weight with me.

I have also noted that the desirability of a gradual phase-in of new production facilities was endorsed by the State of California, Tr. 2729, and the machine tool industry, Tr. 1964, 1973, 1976-79, 2011-12.

I find that it is feasible to mass produce catalyst-equipped cars in 1975 but that the use of catalysts on all cars sold in this country in 1975 would entail a significant risk of economic dislocation arising from the inability to acquire a supply of acceptable catalysts, problems on the assembly-line, or both. These risks could materialize abruptly, and force the unplanned cessation of production, with attendant layoffs of employees and possibly serious disruption of the national economy. While these risks cannot be quantified, I believe, as did the Court of Appeals, that they must be considered to outweigh the slight gain in air quality that might result from requiring catalysts on all 1975 cars. This conclusion is fully consistent with the overall objectives of the Act, and it is the decisive consideration underlying my decision to phase-in catalysts technology, rather than to require its use on all automobiles in 1975.

(c) Warranty and Recall

For reasons already stated, I believe that catalytic converters will reduce automobile emissions in actual use and may well constitute a more efficient means of controlling pollution from conventional automobiles than engine modification even when the catalyst operates at a fraction of its potential. I do not believe that catalyst failure in use will occur to such an extent as to subject manufacturers to extraordinary warranty or recall liabilities.

Manufacturers can protect themselves from liabilities in various ways. As my earlier decision points out,

> "There is no question but that some systems will fail. This does not necessarily mean that repairs will be required at the manu-

> facturer's expense, for the performance warranty and recall provisions are conditioned on proper use and maintenance by the owner. In the case of recall, a 'substantial number' of a class or category of vehicles must be found to exceed applicable standards. Where a manufacturer is required to pay for necessary repairs, the data indicates that relatively simple adjustments to air and fuel inputs to the engine or exhaust treatment components may be effective in many cases to remedy nonconformity with the standards." (May Dec. p. 12)

Manufacturers of catalyst-equipped vehicles should, of course, instruct purchasers not to use leaded fuel. Reduced catalyst efficiency caused by lead "poisoning" will therefore result from violation of the manufacturer's instructions for maintenance and operation of the vehicle and will not subject manufacturers to liability under the Act's warranty or recall provisions.

My earlier decision also points out that

> "It is the manufacturer's obligation to design the vehicle so that operations which may impair emission control are difficult to perform where this is possible, and to caution purchasers against using vehicles in ways or for purposes that can be expected to cause failure of the emission control system. Wherever possible, systems should be built into the vehicle which warn the operator of component failure or impending failure." (Id. fn.)

Catalyst failures caused by continued operation of a vehicle after a warning signal is given to the driver or by operations likely to cause catalyst failure would not result in liability if reasonable and necessary instructions by the manufacturer clearly proscribe such operations.

In addition, the evidence indicates that catalysts retain a substantial conversion efficiency even after severe thermal or mechanical stress. For example, data submitted indicates that in some cases catalysts which had melted as a result of severe thermal stress continued to oxidize more than 70 percent of the hydrocarbon and more than 90 percent of the carbon monoxide emissions from the engine. In other cases, visibly broken or extruded catalysts evidence a similar effectiveness. In such cases, emissions from the vehicle may exceed the certification standard but would not necessarily cause the vehicle to fail an appropriate in-use test.*/

Finally, my decision requiring limited introduction of catalysts during the 1975 model year should permit manufacturers to exercise a high degree of quality control over catalytic units produced in that year. While deficiencies may occur during initial production, the limited scale of 1975 catalyst production should permit manufacturers to correct these deficiencies without undue hardship. The experience gained will, in my judgment, further minimize in-use failures in subsequent production years.

3. Methodology and Interim Standards

a. 1975 Standards

(1) Background to Methodology

The most germane and relevant information for determining what lies within the technological reach of each manufacturer would be "raw" test data on the most effective emission control systems, generated according to the strict procedures of the certification "durability" test procedures. It is understandable, however, that the development programs of manufacturers vary from this ideal in two respects: they have investigated some components and systems which proved not to be as successful as others; and they have accumulated

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*/ It is inevitable that some production vehicles will exceed the certification standard during their useful life even where the vehicle is in all material respects of substantially the same construction as the successfully certified prototype. For this reason, I do not believe that the Act requires that the certification standard govern warranty and recall. If that were so, manufacturers would be required to repair vehicles which differ from the certification prototype only in manufacturing tolerances essential to a mass production system. These vehicles would on the average reflect the same degree of emission reduction as the successfully certified prototype and would, in most cases, have no repairable defect.

mileage by procedures other than the federal certification procedures. Consequently, it is often inappropriate to take the "raw" data from these development programs as indicative of whether a manufacturer can or cannot achieve a specified level of emissions under applicable certification procedures.

To avoid the dilemma of relying either on no data or on somewhat irrelevant data, it is necessary to develop a methodology that does three things: first, it selects some data, excluding those data which cannot be made germane; second, it makes adjustments to the selected data where appropriate to make their emission levels germane; third, using the selected and adjusted data, it determines which are the best systems.

The Court of Appeals recognized the validity of using a methodology to make predictions, but insisted that a showing be made of the reliability of the methodology. This my staff has attempted to do, striving to avoid the features criticized by the Court in last year's decision and in no case relying on assumptions which were not supported by data or reasoned analysis.

Numerous and diverse methodologies were offered by the manufacturers for predicting their ability to meet the 1975 federal standards. In many instances, these methodologies had salutary features. In others, they had flaws such as relying upon "raw" data which was not generated by, or converted to, the federal certification procedures, or relying upon technological halfway houses rather than upon the best systems which had been developed.

An extensive proposed methodology was issued by the Agency to the manufacturers on March 9. Members of my staff and their staffs met for informal discussions on March 17. The manufacturers submitted critiques the following week, with more supplemental material thereafter. Many of the disputed features of the proposed methodology and of last year's methodology have consequently been eliminated or changed. It is unavoidable, of course, that disagreements will remain on some points.

(2) Description of Methodology

The methodology employed herein assesses the state of technology for each engine family being produced by each manufacturer. This significantly expands the data base for each manufacturer from considering a single overall "best system" to considering many. The methodology uses each of these systems in its analysis.

Within each engine family, every effort has been made to distinguish between different systems without mistakenly drawing lines between different vehicles within the same system whose different emissions were due only to test-to-test, car-to-car, or deterioration factor variability. In other words, a "best car" analysis has been avoided and a "best systems" analysis has been pursued.

Where engine families were not the subject of adequate testing on which to perform this rigorous analysis, the emission levels have been assumed to be equal to those of similar engine families. Where no similar engines were tested, the engine family has not been considered to represent either success or failure in meeting the 1975 standards; the results from other engine families have been taken to represent the ability of the manufacturer. These procedures are more reliable than either the "average system" recommendation of Ford or the method contained in the proposed EPA methodology.

Since catalyst failure has been stressed by each applicant, a "failure analysis" has been conducted to determine the relevance of the reported failures to the overall technology of the applicant. In the majority of instances, the "failures" were more apparent than real.

The most controversial aspects of the methodology are likely to be the "adjustment factors." It is in the nature of development programs that not all vehicles will represent the best systems available to a manufacturer. But it would be absurd to give the less-than-the-best systems the same weight in an assessment of the state-of-the-art that is rightfully due to the best systems. On the other hand, to consider only the few instances in which the manufacturer has reached the pinnacle of technology would be to constrict the data base to a practically unusable degree. Consequently, the methodology applies a few carefully selected, conservative "adjustment factors" to estimate what the less-than-the-best systems would have done had they contained state-of-the-art components, been run on the proper fuel, and so forth. The Court of Appeals opinion clearly endorsed the use of such adjustments if they could be supported by relevant data. EPA has excluded several factors which might be justified and included only those in which the level of confidence is extremely high.

Finally, a statistical correction has been applied to take account of the problems of test-to-test, car-to-car, and deterioration factor variability. The Court of Appeals required me to have a high degree of confidence in any conclusions which might lead to a denial of suspension. This high degree of confidence has been assured by the use of a "Monte Carlo" statistical technique (similar to that used by General Motors) which generated the emission level distributions expected to occur when the durability tests are repeated during the "official" certification effort. A quarter of a million calculations were performed, and the predictions contained herein are only those which can be said to represent a 95% confidence level in their accuracy. In short, the odds are 20-to-1 that any vehicle will do better than I have predicted rather than worse.

(3) Results

The result of this conservative analysis has been a conclusion that although General Motors could meet the 1975 standards with at least 93% of its sales, Ford could be assured of meeting them only with 55%, American Motors and International Harvester only with 26%, and Chrysler with none. The overall percentage for the industry would be at least 66%. I do not consider that sufficient to satisfy basic demand. It is likely that even better results could be achieved, but these are confident minimums.

b. Interim Standards

Since the Clean Air Act requires that interim standards be set if a suspension is granted, I have established the standards described earlier. The law requires that such standards

> "reflect the greatest degree of emission control which is achievable by application of technology which the Administrator determines is available, giving appropriate consideration to the cost of applying such technology within the period of time available to manufacturers." §202(b)(5)(C).

Catalyst technology is generally available. But possible production problems could constitute too high a cost in terms of lost production and unemployment if catalysts were required on 100 percent production. These problems will be mitigated to the extent that manufacturers are able to meet the national interim standards without catalysts. Consequently, I have decided upon interim standards for California (including approval of waivers for California) which reflect the levels achievable with catalysts and national interim standards which will not require catalysts on most models. I have given appropriate consideration to the cost of applying such technology within the period of time available to the manufacturers.

(1) California

The levels achievable by a portion of the national production capacity are .9 grams per mile HC, 9.0 grams per mile CO, and 2.0 grams per mile NOx (1975 FTP). At these levels, I expect the manufacturers to market a full range of vehicles in California, although there may well be a few models of some manufacturers which do not meet these standards. Any unmarketed models would be expected to be replaced by other models of the same manufacturer, or by vehicles sold by other manufacturers. In this way, competitive pressure is likely to be a strong force for clean air.

(2) National

The national interim standards are based on a judgment that substantial progress has been made in emission control since the manufacturer's 1973 certification program. To a large extent, the technology is available to allow manufacturers to meet the 1975 standards of 0.41 HC, 3.4 CO and 3.1 NOx. This technology is based on use of catalytic converters, quick heat intake manifolds, air injection, fast release chokes and improved ignition systems. The national interim standards of 1.5 HC, 15.0 CO, and 3.1 NOx could be met by all applicants using this catalyst technology. In addition, most manufacturers are expected to be able to meet these standards without catalysts, using recalibrations and other components of their best systems.

In addition, items such as super quick heat intake manifolds, variable ratio air pump drives, large capacity exhaust manifolds and proportional exhaust gas recirculation systems which were not generally planned for use with catalyst systems could lower emissions further without use of a catalyst.

Currently available engine-modifications and components have resulted in impressive emission reductions, as discussed in the technical appendix to this decision.

While the amount of available data does not lend itself to a quantitative methodology in predicting levels achievable by using the most promising systems without catalysts, the interim standards represent my best judgment of the achievable levels.

4. California Phase-In of Catalyst Technology

I have discussed above my conclusion that catalytic converters have been demonstrated to be effective and safe. Catalysts promise a dramatic gain in automobile emission control and will be required to achieve compliance with the 1975 statutory standards in cars having a conventional internal combustion engine. Although I have determined that installation of catalysts on all 1975 cars carries with it the possibility of serious production problems and that consequently it is in the public interest to provide an additional one-year period before commencing nationwide use of catalysts on all models, I have also found that it is feasible and in the public interest for catalysts to be used on a substantial portion of 1975 vehicles. A phase-in of catalysts during the 1975 model year will lay the necessary foundation for fullscale use of catalysts in 1976.

I have considered a number of options to implement a phase-in approach to catalysts during 1975. Of these, the two basic choices involve: (1) setting a single nationwide set of interim standards at a level which would permit certification of most vehicles without use of catalysts but would require use of catalysts on a larger number of models than the national interim standards prescribed in this decision will require, or (2) selecting a geographical area in which to require catalysts on all cars, while establishing a national standard for cars to be sold in other areas which can be met without catalysts on most models. For a number of reasons I have chosen to adopt the latter approach by requiring catalysts on all 1975 models sold in the State of California.

A number of disadvantages could result from any decision to rely wholly on a single set of national interim standards to force partial introduction of catalysts. The major deficiency is that the requirement to install catalysts probably would fall quite unevenly on the different auto manufacturers. Whatever the level of control that was required, a high risk would exist that the standards would force one or more auto manufacturers to use catalysts on a large part or even all of its vehicles while permitting other auto manufacturers who may enjoy at this time a slight lead in emission control technology to use few catalysts or perhaps none at all. Because such a result would cause most of the experience with catalysts to be developed by those manufacturers least advanced in emissions control technology, the full benefits of phasing-in catalysts might well be lost. In such a case, the financial burdens of the phase-in would also fall unevenly upon the different auto manufacturers and the risks of possible severe dislocations would not be avoided.

By imposing catalyst-forcing requirements on essentially all vehicles to be sold in the State of California, the benefits of an across-the-board partial phase-in of catalysts will be assured. All manufacturers will be required to use catalysts on a significant fraction of cars in each model line, but none will be subjected to the possibly overpowering burdens of placing catalysts on all of its cars.

A number of factors support the advisability of conducting the needed phase-in in California. As I have already noted, there is a well-established pattern that emission control advances have been phased in through use in California before their use nationwide. This pattern grew out of early recognition that auto-caused air pollution problems are unusually serious in California. In response to the need to control auto pollution, California led the nation in development of regulations to require control of emissions. This unique leadership was recognized by Congress in enacting federal air pollution legislation both in 1967 and in 1970 by providing a special provision to permit California to continue to impose more stringent emission control requirements than applicable in the rest of the Nation. California has regularly applied for and received waivers under this provision from the federal preemption of State regulatory authority to control emissions from new vehicles, and California has an existing regulatory structure for implementing and enforcing requirements applicable only to cars sold in California.

The experience of Federal and State officials as well as the industry itself in meeting such standards for

California will facilitate an orderly implementation of the more stringent, catalyst-forcing standards for California in this case. That experience will be buttressed by the capability of California State officials to apply the established State enforcement authorities to implement these requirements. While my decision does not grant fully California's pending request for a waiver for 1975 cars, it grants California's request in substantial part. I have no reason to believe that California will not participate fully in the implementation of this decision. Informal and preliminary discussions with representatives of California, and testimony by California in these proceedings, indicates that California's response will be positive.

I believe that my decision represents a fair and legally proper application of the statutory directive that I set interim standards reflecting "the greatest degree of emission control which is achieveable by application of technology which . . . is available." Under the facts which I have found to exist, maximum utilization of available technology can be achieved only through some approach requiring a phase-in of catalysts. I am sensitive to the emphasis placed by the Court of Appeals on applying the statutory requirements in the manner that best serves the public interest. In my judgment, this approach is clearly the best available alternative to serve the public interest.

In setting interim standards for the rest of the country, I have not felt constrained to avoid any reliance upon catalysts to enable auto manufacturers to meet the certification requirements. I anticipate that for certain model lines catalysts may be required. The likelihood that a significant number of cars will be distributed across the country equipped with catalysts will supplement the experience derived in California in a beneficial way.

If the new technology is largely restricted to California vehicles in 1975, it is the testimony of both General Motors and Ford that all the processes needed to mass produce catalyst cars can be tested out on a limited scale that makes tighter quality control prossible and allows extra energy to be applied to the cure of any problems that may arise. Tr. 30, 130-31, 141-42, 158, 163-64, 167-68, 2403 (GM); F. App. I-14-15, Ford Mem. pp. 63-64, Tr. 271, 276-77, 285-86, 288-89, 2032-33.

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Both companies also stated that they would be able to focus their energies to deal more effectively with such in use failures as did occur if the first introduction of catalysts were in a limited geographical area. Tr. 135 (GM) Ford Mem. p. 64, Tr. 2034, 2194-95, 2972. (Ford)

Finally, both companies urged the desirability of getting field experience with a large number of catalysts before shifting to full national production, though Ford stressed this more than GM. GM App. pp. I-8-9, Tr. 87, 2400 (GM); F. App. p. I-17, Tr. 271, 286, 2131-32, 2195 (Ford). In my view the likely gains on this score are significant, though less important than the gains in production experience. Both GM and Ford are presently starting field tests of large fleets of catalyst-equipped cars from which they hope to learn the major problems such vehicles will encounter in use. Tr. 130-31, 142-46 (GM); Tr. 282-83 (Ford). There should be time for at least one more such test fleet before 1976 certification begins.

Still, some tangible benefits for 1976 vehicles can be expected to flow from field experience with catalysts on some 1975 cars, even though there will not be much more than a few months between the time such vehicles go on sale in the late summer of 1974 and the start of 1976 certification testing in the fall of that year. Experience can be gathered on how to service these cars and correct any problems they may have in use. In addition, some corrections thought desirable in the light of phase-in experience may be incorporated on 1976 vehicles as "running changes," even after certification testing has begun. Tr. 158.

Of the other two auto companies, American Motors has somewhat reluctantly recognized the desirability of introduci catalysts on a limited basis in 1975, Tr. 3005-06. Only Chrysler remains unalterably opposed, Tr. 381, 399-400, 3051, though it has accepted the desirability of such an approach in principle. Tr. 451.

Concern was expressed that limited introduction of catalysts a year before their nationwide use would lead to a significant price increase in certain components. This fear was expressed by Engelhard, Tr. 1016-18, Matthey Bishop, Tr. 1313-15, UOP, Tr. 1398-1401, W. R. Grace, 1430-31, and Corning, Tr. 1498-1500. These witnesses foresaw a price increase for the substrate and its coating due to inability to realize full economies of scale. No price increase is foreseen for the can. Tr. 1547.

For a number of reasons, I conclude that this fear is not of overriding importance. Each of the witnesses indicated that it might well be possible to reduce or even eliminate such price increases if capital costs were reduced by the use of smaller or existing facilities. Tr. 917-18 (Engelhard); 1314-15 (Matthey Bishop); 1402-03 (UOP); 1431 (W. R. Grace); 1484-85 (American Lava); 1500-01 (Corning).

The two major auto companies each indicated that even if any likely cost increase were passed through to the consumer, the resulting rise in sticker price would not exceed $45. Tr. 2819-90, Ford Mem. p. 66 (Ford); Tr. 2419-20 (GM).

Finally, competitive pressures will be at work to hold California prices down. If even one major company finds that the pricesof its catalysts do not rise very much, all others in the market will be pressed to match the prices the first company can offer. Even in the very unlikely event that no American company finds itself in such a position, competition from Honda and Mazda (each of which makes a disproportionate percentage of its U.S. sales in California) can be expected to hold prices down.

5. <u>The 1973 Report of the National Academy of Sciences</u>

Under Section 202(b)(5) of the Clean Air Act, I may only grant a suspension if a study of auto pollution controls which the Clean Air Act requires to be made by the National Academy of Sciences "has not indicated that technology, processes, or other alternatives are available to meet such standards." The Court of Appeals placed particular emphasis on this test, stating that

> "Congress called on NAS, with presumed reliance on the knowledge and objectivity of that prestigious body, to make an independent judgment. The statute makes the NAS conclusion a necessary but not sufficient condition of suspension." Dec. p. 59.

The Court also said:

> "While in consideration of the other conditions of suspension, EPA was not necessarily bound by NAS's approach, particularly as to matters interlaced with policy and legal aspects, we do not think that it was contemplated that EPA could alter the conclusion of NAS by revising the NAS assumptions, or by injecting new ones, unless it states its reasons . . . possibly by challenging the NAS approach in terms of later-acquired research and experience." Dec. pp. 59-60.

In its most recent Report, and in its testimony at the hearings, the NAS addressed each of the three components of a conclusion that technology is "available" and "effective" to achieve compliance, namely: (i) ability to certify, (ii) ability to produce the vehicles certified, and (iii) ability of these vehicles to comply in use.

The Academy concluded that conventional engines equipped with catalysts "will meet the prescribed emissions standards during certification testing." NAS Rept. p. 2. Under questioning at the hearing, it was explained that this statement meant that "a substantial number of vehicles will qualify." It did not exclude the possibility that a smaller, but still significant number of vehicles would not qualify, Tr. 1602, 1604, 1625. This is wholly consistent with my finding. (P. 15, above). Nor does the Academy expect that a manufacturer would be able to predict which of his vehicles would certify and which would not in advance of the completion of certification testing. Tr. 1604-05.

The Academy further concluded that vehicles incorporating certified systems "can be mass-produced in great enough volume to satisfy, in aggregate, the expected demand for vehicles in model year 1975," NAS Rept. p. 2. The NAS adhered to this position at the hearing, Tr. 1581-82; 1599; 1624-28, although it refused to speculate on the extent to which production problems might result. I do not disagree that it is physically possible to equip 1975 cars with catalysts. The question remains whether to force catalysts on all cars in 1975 is in the public interest. My finding on the feasibility of mass production (p. 18, above) was based on evidence indicating a significant risk that production problems could materialize and could have substantial effects on the national economy.

Finally, the NAS stated that there were good reasons to doubt whether vehicles in actual use would meet the standards under which they were certified. NAS Rept. 69-72, 85-86, 115-116, 124-125. NAS stated at the hearing that these fears were based mostly on a lack of sufficient field data concerning more stressful conditions that might be encountered by catalyst-equipped cars in actual use. Tr. 1615-17.

The NAS findings read in the light of the Court's opinion do not appear to constitute a legally sufficient conclusion that technology is available to meet the statutory standards. The NAS itself admitted that there is a chance that a significant number of engine families would not certify and did not deny that production problems were a significant possibility. The NAS did not have the benefit of the Court's opinion, and in addressing the issue of technical feasibility of compliance with the standards the NAS apparently did not believe that these risk-balancing considerations were relevant. However, in addressing these and other considerations elsewhere in its report, a majority of the NAS Committee expressed the view that suspension of the standards for one year would be "prudent," NAS Rep., p. 126; and the report presents data which indicates that the effect of a one-year delay on national air quality would be relatively slight. Id. pp. 119-124.

For these reasons, I believe that the several NAS reports, including the most recent report, are consistent with my conclusion that a phase-in of catalysts in 1975 is in the public interest.

6. The Public Interest

The compelling reasons which cause me to find that the public interest requires a suspension of the 1975 standards have already been discussed. The other reasons urged on me for finding that suspension would be in the public interest are in my judgment insubstantial. The reasons most commonly cited are that increased fuel economy and better performance and driveability would result from a suspension, and that the grant of an extra year would give the industry "breathing room" to switch over to a means of emissions control superior to catalysts. I will discuss these claims and certain considerations urged upon me for denying suspension in this section of the decision.

a. Fuel Economy

Testimony on the impact that achieving the 1975 standards through use of a catalyst would have on fuel economy varied over a narrow range. GM stated there would be no loss in fuel economy over present levels, and might even be a slight gain. Tr. 176-78.

Ford's submission also contained data to show that its most representative durability fleet of 1975 type vehicles had approximately the same fuel economy as 1973 certification vehicles. F. App. p. 4-46. Another group of vehicles which aimed at greater NOx control than will be required in 1975 had demonstrated a 6% fuel penalty. After questioning by the hearing panel regarding this apparent inconsistency, Tr. 309-14, Ford submitted new data comparing the 1975 durability fleet with 1973 production vehicles that showed a 3.9 percent fuel economy loss. Tr. 2048-60. Since Ford has traditionally calibrated both its test and its certification cars with significantly different air/fuel ratios from its production models, limited weight can be given here to such a comparison.

Chrysler introduced no miles-per-gallon data at all, but under questioning by the panel stated that its estimate of the penalty was 3%, which was described as "negligible." Tr. 423-25. An internal Chrysler status report dated last fall indicated there would be no mileage penalty associated with the 1975 catalyst system, EPR minutes 9/8/72, but Mr. Heinen testified that studies received thereafter had led to a correction of that figure. Tr. 3228-29.

American Motors testified that there would be "essentially no fuel penalties" associated with the use of a catalyst. Tr. 905. This was also the testimony of Engelhard, Tr. 1018, UOP, Tr. 1326-27, American Lava, Tr. 1469, Nissan, Tr. 1890, Mobil Oil, Tr. 1695, and New York City, Tr. 2232. Volkswagen estimated the penalty at "zero to five percent." Tr. 1859.

On this record, I conclude that there is no significant evidence that more than a three or four percent mileage penalty will be associated with the use of catalysts in 1975, and that the great weight of the evidence suggests that there will be little or no penalty at all in comparison to emission control systems on 1973 vehicles.

The best data available indicates that a two percent increase in petroleum consumption will be required to refine gasoline to required octane levels without use of lead additives to prevent catalyst "poisoning" by leaded gasoline. Tr. 1655. Chrysler estimates that a 4 cent per gallon price increase will result from this refining penalty. Tr. 430-31. However, the Bonner and Moore study*/ (which seems supported by more persuasive documentation) indicates that less than a quarter of a cent increase in production cost will result.

b. Performance and Driveability

The only one of the applicants to suggest that 1975 cars with catalysts may show a decrease in either performance or driveability, as compared to current cars, was Ford Motor Company. F. App. 1-15, 2-87.

However, in a letter to Dr. N. D. Shutler of EPA dated March 28, 1973, Ford supplied driveability data for a "representative sample" of its 1973 production vehicles. Comparison of these figures with the driveability ratings supplied for Ford's Riverside West fleet, at F. App. pp. II-180-89, reveals no significant differences.

In a March 28 letter to Dr. Shutler, General Motors indicates that the driveability of 1975 vehicles is expected to be at least equal to that of the 1973 models.

c. Development of Alternative Technologies

Both the Court of Appeals and the NAS have suggested that a suspension might be in the public interest because it would give manufacturers time to adopt alternative emissions control technologies superior to the catalytic converter. In response to this concern, EPA has carefully investigated the development status of such technologies, chiefly the rotary, the diesel, and the Honda CVCC engine.

It does not yet seem clear that either the rotary or the diesel can be confidently regarded as markedly superior

*/ "An Economic Analysis of Proposed Regulations for Removal of Lead Additives from Gasoline," Bonner & Moore Assocs., Inc. (March 1972).

to the present engine. Though Toyo Kogyo has achieved the 1975 standards with a rotary engine, Tr. 1786, their engines suffer a fuel penalty of between fifteen to seventeen percent compared to conventional engines. Tr. 1792. GM, which claims to be on the way to solving the fuel economy problems of the rotary, Tr. 219-20, has not yet been able to achieve the standards. Tr. 27.

The diesel, though superior in fuel economy and in emissions control, has found only limited customer acceptance, though this may change if the price of gasoline continues to rise. Tr. 208-10, 1902-03, 1919-23. The major problem with widespread use of diesel engines in passenger cars concerns particulate emissions and odor. While these are not a problem now, with only a few diesel-powered cars on the road, an increase in the number of diesels could create a serious problem.

The Honda CVCC engine is a different case. All Honda vehicles tested by EPA have met the 1975 standards with ease. Honda has reported that a Vega modified to the use of their system also met the 1975 standards, and its fuel economy improved. At the hearings, Honda presented the first data points from a standard-sized Chevrolet that had been adapted to meet the standards, and has since issued a press release, unverified by EPA, stating that another such car has been successfully modified. Since the Honda system rests on changes in the actual structure of the combustion chamber, there seems no reason to expect that its performance will deteriorate with use any more than present systems.

It is true, nevertheless, that not much is known about the Honda engine. GM, the American manufacturer whose negotiations with Honda appear to be furthest advanced, has not yet been told exactly how the system works. Tr. 2994. As yet there is no clear assurance that the same approach will work for larger vehicles, though the preliminary reports are encouraging. Nor is there a sufficient data base to predict with confidence what the fuel economy performance of the CVCC really is. Finally, although the CVCC system is said to be inexpensive, NAS Report p. 101, definitive information on that point is not yet available.

Although these potential difficulties should be noted, I do not dispute the NAS judgment that the CVCC system appears to constitute superior technology, particularly as regards durable emission control. The record is clear, however, that even if the other manufacturers elected today to employ the CVCC system on their vehicles as rapidly as possible, it would take considerably more than five years to modify existing production equipment.*/ Control of emissions to anything like the statutory 1975 levels will therefore almost certainly depend on the use of a catalytic converter on large numbers of vehicles for a substantial period of time.

In addition, I am convinced that the best way to accelerate development and use of a superior technology is to put strict emissions control requirements into effect as soon as they are technologically feasible. The merit of the Honda appears to lie in its ability to achieve low emissions levels without some of the difficulties that are associated with other approaches. If that is indeed the case, the sooner strict standards are adopted the sooner the Honda engine will be able to show its true strength in the marketplace. When this happens, other companies will be spurred by competitive forces to adopt it.

Honda itself plans to put CVCC engines into production this summer on its 1974 cars for the Japanese market. NAS Rept. p. 97. Honda plans to sell cars with CVCC engines in the United States during the 1975 model year. Tr. 1758.

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*/ Not even Honda thought it would be possible to produce any American cars with their system by 1975, Tr. 1774, though GM may be exploring the possibility of doing just that for the Vega with parts imported from Japan. Tr. 2992-94. One GM witness had testified previously that if granted an extension, GM would "consider" use of the CVCC for the Vega in 1976. Tr. 198. Another seemed to say that not even this much would be done. Tr. 197-98. Ford, Chrysler, and American Motors all claimed it would be impossible to install the Honda engine on any of their cars by 1976. Tr. 322 (Ford); Tr. 391 (Chrysler); Tr. 2392 (American Motors). Two machine-tool manufacturers expressed their opinion that it would take twelve years to convert the auto industry to produce a completely new type of engine, such as the Wankel. Tr. 1938-39; 2013. While the CVCC system may not require such extensive changes, Tr. 1764-65, Ford has claimed that widespread introduction of the Honda engine is not possible until 1978, F. App. 4-77-78, and that the complete change-over will take a decade. Ford Mem. p. 65. Chrysler made the same estimates. C. App. p. IV-E-4. See also Tr. 197-98 (GM); Tr. 3031-32 (Chrysler).

d. <u>Consideration supporting denial of suspension</u>

Under the heading of "public interest" it is also necessary, of course, to discuss any reasons why a suspension might not be in the public interest. Clearly the overriding consideration here is the urgent need to clean up this country's air, and particularly the air of our major cities.

The possibility that any decision to suspend may have the effect of delaying the necessary improvement in our air must be addressed.

On the record before it last February, the Court of Appeals found that the environmental effects of a one-year suspension would be "relatively modest," even if no interim standards more stringent than the 1974 standards were established, and directed me to weigh adverse effects on air quality lightly against the risk of economic harm. This judgment of the Court relating to air quality impact was challenged by some witnesses at the public hearing.

The two sets of interim standards I am promulgating today will help to ensure that the environmental impact of suspension is in fact "modest." The high degree of pollution control these standards represent has already been presented. It is the best judgment of my staff that if cars sold in the 1975 model year meet these interim standards, rather than the 1975 requirements, no measurable difference in carbon monoxide concentrations will result in 7 of the 25 air quality control regions that currently will require transportation controls, and no measurable difference in concentrations of hydrocarbon products (oxidants) will result in 21 of the 26 air quality control regions needing transportation controls for hydrocarbon emissions.*/ This analysis assumes, of course, that cars sold in 1976 and thereafter will meet the statutory 1975 standards for hydrocarbons and carbon monoxide.

In addition, there is some possibility that the introduction of catalysts nationwide in a single model year might lead to reduced car sales in that year and thereby offset any gain in new car emission reduction by slowing down

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*/ Five of these 26 regions are in California and will benefit from the stringent 1975 California standards promulgated today.

the rate at which older, high-polluting vehicles are retired from service. I find it highly unlikely that such a result would stem from customer rejection of the 1975 models, since they are expected to have essentially the same performance, driveability and fuel economy as the 1973 models which are currently selling at a record rate. However, production difficulties that could lead to a reduction in the number of cars reaching the market might have this effect. It appears that losses in production due to nationwide catalyst use could be enough to offset any increase in air quality due to gains in emissions control performance. F. App. pp. 5-103-113, esp. p. 112.

Finally, where additional transportation controls are needed, local jurisdictions outside California may require fleet vehicles to be fitted with catalysts as a condition of licensing for commercial operations. My decision to require catalysts on all California models in 1975 will assure that a representative range of new 1975 vehicles with catalysts will be available for fleet purchases in major cities.

e. Lead-Free Gasoline

Catalyst-equipped vehicles require gasoline with a very low lead content in order to avoid lead "poisoning"*/ of the catalyst. Since the interim standards established by this decision will require catalysts on all vehicles sold in California, many of which will undoubtedly travel to other parts of the country, and on a significant number of vehicles sold in the other forty-nine states, lead-free gasoline must be generally available nationwide by the beginning of the 1975 model year. This will be accomplished by regulations that have already been promulgated. 38 Fed. Reg. 1254 (January 10, 1973).

The regulations require a maximum trace lead content of 0.05 grams per gallon with the goal of achieving 0.03 grams per gallon on the average. Although some skepticism has been expressed as to whether an average lead content of approximately .03 grams per gallon will actually be achieved

*/ "Poisoning" is a dramatic name for a simple phenomenon, namely, the loss of catalytic activity when lead in the gasoline settles on the catalytic surface and, by coating it, prevents it from reacting with the exhaust gases.

in the field, the information available to me reveals no substantial doubt on that score. Amoco (letter of May 9, 1972, from B. J. Yarrington to Deputy Assistant Administrator for Air Programs, EPA), Texaco (letter of March 19, 1973, from W. J. Coppoc to Dr. N. D. Shutler, EPA), Exxon (letter of March 26, 1973, from D. F. Dickey to Dr. N. D. Shutler, EPA), and Mobil, Tr. 1745-46.

7. Good Faith

The Act requires that, before I grant an extension of time to any auto manufacturer, I must find that "all good faith efforts have been made to meet the [1975] standards." Serious questions have arisen in these proceedings as to whether such a finding would be proper in the case of Chrysler Corporation. These questions arose as a result of testimony by a representative of Engelhard Industries that Chrysler had refused to purchase catalysts from Engelhard for reasons materially influenced by the aggressive testimony of Engelhard at the EPA hearings last year. Because of these charges, six volumes of additional documents were subpoenaed from Chrysler, and two additional days of hearings were held. All this evidence has been carefully examined, along with what was already in the record, and my conclusions based on it are set out below.

The central question focused on in the hearings was why Chrysler awarded a catalyst supply contract to Universal Oil Products Company, and not to Engelhard Industries, in September 1972. A secondary question concerns the award of a 100% catalyst requirements contract to UOP in March of this year. To answer these questions, detailed inquiry into events at Chrysler between May 1972 and the present was necessary. Before briefly summarizing the results of that inquiry, however, it is appropriate to make two points by way of background.

First, according to figures supplied by Chrysler and other auto manufacturers, C. Mem. p. 49, Chrysler's spending on emissions control has varied between a sixth and a tenth that of Ford and General Motors in each of the three years since the Clean Air Act was passed. These figures indicate that Chrysler has been spending about a third as much for this purpose per dollar of sales volume as General Motors and Ford. In addition, both Ford and General Motors are presently preparing test fleets of catalyst cars to operate in the field. Chrysler testified that it had no firm plans to do anything similar. Tr. p. 3073-74, 401-02.

Though these comparisons are not favorable to Chrysler, they are by themselves not necessarily decisive. Chrysler's emissions research expenditures, on a market share basis, have been about equal to American Motors', while the percentage of Chrysler research dollars going to emissions control compares with the percentage for the other members of the Big Three. It may be that in the auto industry there is a minimum company size or market share below which the capacity to fund research falls off noticeably. Nevertheless, I am seriously troubled by the level of Chrysler's expenditures on emission control research, particularly when this fact is considered with other questions that have been raised concerning Chrysler's emission control development program.

The low level of Chrysler expenditures does make it disturbing to turn to the record of Chrysler's pollution control activities in the first half of 1972 and find that in that period criticism was expressed within the Chrysler organization that the Chrysler efforts were not adequately concentrated on meeting the 1975 requirements. One member of the Emission Policy and Review Committee, H.R. Steding, protested against a diffusion of energies on two separate occasions. EPR Minutes for 3/7/72 and 5/2-4/72. See also Tr. 3091-93.

A full review of the history of Chrysler's catalyst development efforts during the period at issue here is not possible within the confines of this decision. In brief outline the salient features are as follows.*/

During the spring of 1972 it appears clear that Chrysler regarded a noble metal monolithic catalyst as far more promising in performance than pebble type catalysts and that Engelhard was the first choice among catalyst suppliers furnishing monolithic catalysts to Chrysler. Following my decision announced last May, Chrysler officials exhibited a considerable sense of urgency to finalize selection of their first choice system and make commitments for production.

*/ Supporting details are contained in Appendix A, which is a part of my findings in this matter.

Nonetheless, the decision was deferred, and during the summer of 1972 Chrysler devoted considerable efforts to evaluation of pebble catalysts, motivated in part by the expectation that they would be cheaper than monoliths. In the course of these efforts UOP emerged as a promising possible vendor of pebble catalysts.

In September 1972 Chrysler decided to use a monolithic catalyst and entered into an arrangement with UOP to develop and produce such catalysts. At that time Chrysler had no vehicle test experience with UOP monolithic catalysts. All its vehicle durability tests of monoliths had been with Engelhard monoliths.

The vexing technical question raised by this Chrysler decision is the extent to which it returned the Chrysler catalyst program to a more preliminary state of development. It would seem apparent that considerable problems and lost development time would necessarily result from choosing a manufacturer with little experience in monolithic catalysts over one which had long been a leader in the field. The record indicates that such problems and lost time have in fact occurred. Indeed considerable evidence was presented that during the six months following their initial agreement Chrysler and UOP have been attempting, with a degree of success that remains unclear, to catch up to the technical capability developed by Engelhard.

It is apparent that in both the September 1972 decision to begin cooperative work with UOP and the March 1973 decision to deal exclusively with UOP for acquisition of catalysts, Chrysler was strongly influenced by considerations of cost savings. The lack of clarity on the extent to which performance of catalysts and speed in the development of technology may have been sacrificed as a trade-off against anticipated cost savings presents disturbing questions with respect to the good faith efforts of Chrysler. I find that certain sacrifices in the progress of its technology were made by Chrysler to achieve cost savings.

The initial question which triggered this inquiry likewise remains in doubt. The record does not support a determination as to whether or not Chrysler's decision against purchasing catalysts from Engelhard was materially influenced by antagonisms aroused by the testimony of Engelhard at last year's EPA hearings. I am particularly disturbed by this question because of a possible conflict in the testimony under oath by representatives of Engelhard and Chrysler.

It is possible that the difference between the versions of the September 22 meeting given by Engelhard and Chrysler representatives reflect different recollections of the same statement. If I were forced to choose between one or the other of those versions, the one put forward by Mr. Leventhal of Engelhard would seem more probable. One salient fact inclining me to that view is that the handwritten notes from which the official Chrysler minutes of the meeting were prepared indicate that Mr. Bright of Chrysler made a statement similar to the one which both Engelhard representatives present at the meeting testified he made.

On such a record, the gravest questions as to Chrysler's compliance with the statutory requirements must arise. But a determination that they have not been met cannot be lightly made. UOP is a well-established company with a past and present reputation for excellence, and there is evidence that this was a major influence in Chrysler's choice. Tr. 3149-50. In addition, the Court of Appeals has directed me, in weighing the proof applicable to determinations in this proceedings, to take account of the consequences of a wrong decision either way.

With regard to Chrysler, I conclude with serious reservations that the statutory requirements concerning good faith have been met. In reaching this conclusion, I am placing decisive reliance upon the consideration that the sanction that arises from a negative finding on this issue with respect to a particular manufacturer could force that manufacturer to close down in 1975. Such a result would not only create extreme hardship for large numbers of innocent employees of the manufacturer concerned but would also severely impact numerous suppliers of the manufacturer and ultimately the public at large. Thus, despite the very serious questions I have concerning the record as it relates to Chrysler on this point, I do not believe that Congress intended me to make a finding of bad faith in the absence of a very high degree of certainty that the acts of a particular manufacturer require such a finding. On this record, Chrysler's defense of its procurement decisions and of its acts with respect to Engelhard have raised sufficient doubt to preclude a positive finding of bad faith.

No such substantial questions arise as to the good faith efforts of the other applicants. I found last year that, as far as financial commitments in this field were concerned, "efforts of the automobile industry as a whole would appear to meet the test of good faith." May Dec. pp. 22-23. In the last year, those expenditures have substantially increased.

I also found last year that a coherent program aimed at timely compliance with the statutory standards was an ingredient of "good faith." The success of General Motors' program in generating the test results that have been discussed is evidence that the program has been so organized.

Ford has also carried on an ambitious testing program and in recent years has increased its spending on emissions control more than any other manufacturer. In addition, Ford was the first manufacturer to enter into formal financial arrangements with a catalyst manufacturer.

Although the smaller two applicants, American Motors and International Harvester, appear to be limited by their size in the degree of independent emissions control research they can carry on, their efforts appear to meet the statutory standards when that fact is considered.

All of the applicants have evidenced a slowness to pursue alternate technologies that I have found both disturbing and frustrating. It seems fairly clear now, that if these companies had begun early in 1971 to develop a capability to produce other kinds of engines, and particularly the stratified charge type engine developed by Honda, large numbers of 1975 automobiles could probably achieve the statutory standards. I recognize, however, that in making this criticism of the manufacturers development programs I am aided by hindsight. For I cannot be certain that the low emission potential of alternate engine systems such as the stratified charge engine, and the adaptability of alternate engines to a wide range of automobiles, could have been foreseen two years ago. Indeed, as I have stated above, we know relatively little about the stratified charge engine at this time.

The manufacturers generally may have demonstrated undue conservatism and a lack of foresight in not pursuing alternate systems more vigorously. However, I cannot conclude that their present state of progress in these areas is a result of bad faith on their part.

8. Multipurpose Vehicles

In the same section of its opinion that excluded light weight trucks from the category of "light duty vehicles" subject to the 1975 emissions standards, the Court of Appeals raised a serious question as to whether "multipurpose vehicles," such as those made by International Harvester, differed at all from such trucks in their ability to control emissions. Dec. pp. 38-42. The Court left open the question of whether multipurpose vehicles should continue to be classed as "light duty vehicles" and whether, even if so classed, should be entitled to suspension as a subclass.

The information available to me indicates that the design of multipurpose vehicles is such that the great majority more closely resemble light duty trucks than light duty vehicles. Accordingly, I am today determining that all vehicles under 6,000 pounds GVW which are designed primarily for the transportation of property or are available with special features enabling off-street or off-highway operation and use shall be considered as light duty trucks. The standards to be applied to these vehicles will be determined as a result of the proposed rulemaking issued for light duty trucks on March 14, 1973 (38 F.R. 6906).

IV. Administrative Finality

The decision issued today is final for purposes of judicial review, and no formal agency proceedings for its reconsideration are presently contemplated. The Court of Appeals has emphasized, however, that even such a "final" decision remains open to a petition for reconsideration or modification, and that such petitions, if found meritorious, should be acted on.

William D. Ruckelshaus

April 11, 1973

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APPENDIX A

This appendix contains a more detailed narrative of Chrysler's dealings with catalyst suppliers in the period May 1972 to the present than is set forth in the main body of the opinion. It is part of the findings of fact in this proceeding. Much of the data is drawn from minutes of the Emissions Policy and Review Committee (cited "EPR"), the group charged with overseeing Chrysler's emission control program.

It is clear that in late May and early June of 1972, Chrysler regarded the necessity to choose very quickly between the use of a pellet or a monolith catalyst as pressing. On May 30, Mr. Bright, the man in charge of Chrysler's emission control effort, said in an EPR meeting that the choice would have to be made "within ten days," EPR Minutes 5/30/72, and Mr. Steding, an EPR member, reemphasized the point two weeks later. EPR Minutes 6/13/72. See also C. Doc. Vol. V, Sec. 1, p. 3.

It is also clear that if the choice had been made then, a monolithic catalyst would have been chosen, and it appears that the choice would most likely have been Engelhard. At the EPR meeting of May 30, Engelhard was listed as the first choice of the three monolithic catalysts mentioned, while use of a pebble at all was stated to be "contingent on satisfactory car tests." A technical report prepared for that meeting by Dr. Teague, the head of Chrysler's catalyst research, stated that the tests of Engelhard catalysts had given "good results," C. Doc. Vol. VI; Tr. 3119. At the EPR meeting on June 13, Mr. Steding said the choice between pebble and monolith had to be made, and that he had "no alternative" to assuming that the monolith would be chosen.

But the choice was put off, apparently to allow intensive testing of pebble catalysts over the summer. Chrysler has claimed that the heat resistance properties of the new pelleted catalysts that became available in the late spring of 1972 motivated this choice. Tr. 2907, 3127, 3121. Though I do not question that this was a factor, the evidence does not indicate that pebbles tested in that period proved to have heat resistance superior to the Engelhard monolith. Compare EPR Minutes 5/30/72, research report and Figs. 3 & 4, EPR Minutes 6/13/72 ("platinum on monolith was the most heat-resistant catalyst"), and attached research report; research report attached to minutes of 8/22/72 EPR Meeting with EPR Minutes 6/13/72 ("early tests show [two pebble catalysts] to be as good or better than the Engelhard platinum monolith"); chart attached to EPR Minutes of 8/8/72.

I therefore conclude that Chrysler explored the possibility of substituting pebbles for the monolith not primarily to gain in heat resistance, but to realize other advantages of the pellet such as greater ease of servicing, EPR Minutes 7/25/72, C. Mem. p. 54, and potentially lower costs, EPR Minutes 9/21/72, (research report); C. Doc. Vol. V, Sec. 2, pp. 7-8.

When the results of vehicle testing became available in the late summer of 1972, the monolith came out ahead. Tr. 3132-33.

Accordingly, the decision was made to use a monolith in the 1975 first-choice system, and it was on that basis that a letter of intent was entered into with UOP on September 15, 1972. Tr. 2932, 3136.

At the time this letter was executed, Chrysler had no vehicle test experience with UOP monolithic catalysts, Tr. 2921. The first such tests began in December, and two of the first three catalysts tested suffered "catastrophic failure." C. Doc. Vol. V, Sec. 2, p. 30. Chrysler attributes this to engine failure not associated with the catalyst.

At the time of the September decision, all of Chrysler's nine durability test vehicles for monolith catalysts had been run equipped with Engelhard monoliths. Six of these cars had completed their runs and three were still running. Tr. 2916-17. Chrysler testified that the results from these tests were "in the ball park of meeting 1975 standards," Tr. 2926.

Such a record, in my view, makes it most unlikely that the choice of UOP over Engelhard was based on an assessment of the relative technical capacity of the two companies, and places a heavy burden on Chrysler if it seeks to show that that was in fact the case. In response, Chrysler has offered four separate explanations, none of which I find fully convincing.

The first is that Chrysler thought UOP would be able to use the process by which they had made a more heat resistant pellet of gamma alumina to make a more heat resistant gamma alumina washcoat for the monolith. Tr. 2882, 2922, 3123, 3149-50.

Although I cannot say that such a hope was unrealistic, the record indicates that Chrysler must have known there would be difficulties in achieving it. In a pellet the catalytic material is applied directly to little pebbles of gamma alumina, while in a monolith the alumina must first be spread on, and firmly attached to, a two-dimensional surface.*/ Tr. 3163-69. In fact, the research report attached to the EPR minutes of October 3, 1972 indicates substantial uncertainty over whether the technology could be transferred. "Very tentatively, it appears that U.O.P. may have more to contribute on the primer [washcoat] application process" (emphasis supplied). The same uncertainty to a lesser extent was indicated by UOP in a letter discussed at Tr. 3066-68. The research report for the EPR meeting of January 10, 1973, indicates that a washcoat to substitute for UOP's was being tested in the Chrysler laboratory.

Chrysler also argues that UOP was more willing than Engelhard to cooperate and share its knowledge with Chrysler. C. Mem. 56, Tr. 2883, 3057, 3059-60. However, a December 27, 1972 letter agreement between Chrysler and UOP indicates that UOP gave Chrysler permission to analyze the UOP monolith, but not the pellet with which UOP has worked considerably more intensively. C. Doc. Vol. IV. A letter of May 19, 1972 set forth at C. Doc. Vol. III, Sec. 2, shows that even without a supply contract Engelhard had agreed to let Chrysler make analysis of its catalysts to determine how "poisoning" occurs.

A third and closely related point is that until the fall of 1972 Chrysler had experienced considerable difficulty in getting samples of Engelhard's new catalyst, the II-B, to test. C. Doc. Vol. V, Sec. 2, pp. 10-11. There does appear to be validity to this argument, Tr. 3071-72, although the EPR minutes contain no record that any such problem was ever brought to the Committee's attention. However, even the old Engelhard monolith, for which there is no record of supply difficulties, had by far the best record of any catalyst tested.

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*/ Some idea of the technical complexity involved in making monolithic catalysts can be obtained by examining the patents at the back of C. Doc. Vol. III, Sec. 1.

Finally, Chrysler claims that Engelhard insisted rigidly on becoming the supplier for 65% of their catalyst requirements, while UOP was willing to settle for as little as 40%, and to include an escape clause binding UOP to match the performance of any other catalyst maker, C. Mem. pp. 55-57, Tr. 2934-35, 3060, 3144, 3155. Nevertheless, the commitment to UOP was necessary, as Chrysler itself admits, because lead time for the 1975 model year was getting very short, and it was necessary at that time to make commitments to catalyst makers that would allow them to start construction of the necessary facilities. C. Mem. pp. 55, 57, Tr. 2883. In such circumstances it would appear that the claimed "flexibility" existed more on paper than in reality. Since every passing month would make it harder for any potential Chrysler commitment to another company to bear fruit in time for 1975, the September commitment as a practical matter probably locked Chrysler into relying on UOP for at least a substantial portion of its requirements.

It appears that much was surrendered to gain these four claimed advantages. It would seem clear that considerable problems and lost development time would necessarily result from choosing a manufacturer with little experience in monolithic catalysts */ over one which had extensive experience in the field. The record indicates that such problems and lost time have in fact occurred.

In its submission dated this March, Chrysler said that six months after its commitment to UOP, "the Engelhard catalyst is the most active and durable of all the catalysts tested." C. App. IV-A-25. Faced with this statement, one Chrysler representative indicated that the data available as of March 1973, did not entirely support the wisdom of the September commitment. Tr. 1115.

The Chrysler documents from September 1972 to the present bear out that judgment. They show that Engelhard catalysts were constantly used as a standard of reference, to be equalled if possible. EPR Minutes 1/10/73 (research report); EPR Minutes 1/23/73; EPR Minutes 1/23/73 (research report).

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*/ C. Mem. p. 57 states that UOP indicated at a meeting on July 25, 1972, that they had "extensive experience" in monoliths. An examination of the document cited as support for this assertion does not appear to bear it out.

("In all of these laboratory tests [of other catalysts], as well as car and dynamometer tests, the Engelhard catalyst has served as a standard of excellence.") */ EPR Minutes 2/20/73 (research report).

I do not regard the severely limited test data at C. Mem. pp. 1b-7b as proving the contrary. Even if test results at 500° only are taken as representative of catalyst activity over the entire temperature range (which they are not), the problem that Chrysler has laid almost all its stress on, both in discussing the washcoat and in its emphasis on "catastrophic failure" is durability in use. The activity tests do nothing to prove the durability of the UOP catalyst.

Chrysler has also submitted two recent dynamometer comparisons of the endurance of Engelhard and UOP catalysts, which appear to show marginally better performance by UOP. C. Mem. pp. 8b-9b. It is not clear how much importance can be attached to such severely limited data, and Chrysler itself appears to place limited significance on it. At the most, it would indicate some probability that UOP has caught Engelhard in the laboratory, and that nothing can be said about whether this will still be true for vehicle tests. The Chrysler submission states that car tests to date indicate "poor durability for [UOP] catalysts, far below that needed to meet the 1975 standards." C. App. p. IV-F-18. The two examples cited to support this point seems to be the same catalysts whose melting was attributed to "engine failure" in the passage from C. Doc. Vol. V, quoted above.

On balance, I therefore conclude that although some of the technical explanations for UOP's selection have merit, they would themselves have been far from enough to cause Chrysler to select UOP over Engelhard, particularly in view of the great disparity in test data available from the two companies.

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*/ Chrysler argues that test results from this period showing Engelhard superior to UOP are misleading, since all the UOP catalysts were tested, but only those Engelhard catalysts were tested that passed Engelhard's quality control. There is some force to this point. But the minutes quoted here note that all UOP catalysts were tested, say that some portion of their poor performance can be attributed to that, and on balance still recognize Engelhard as clearly superior.

A reason for UOP's selection that seems more persuasive than any of the above is price. Mr. Heinen testified that the September contract was made by submitting a list of four acceptable companies to the Chrysler purchasing department and letting them pick the lowest bidder. Tr. 3148, 3152. See also Tr. 1121, 1123, 1135. The August work sheets in C. Doc. Vol. I are entirely consistent with this testimony, for they are set up to compare four companies on the basis of price alone. Mr. Bright testified that price was an important factor, Tr. 1134, 1140, as did others, Tr. 1101, 1105, 1114. I find that a price comparison among companies was in fact a dominant influence in the decision.

The difference in the ultimate price of the car that would have resulted from accepting the Engelhard September quote rather than the one made by UOP appears to be $5. Tr. 2946.

It is even clearer that price was a primary motive for the choice made in March of 1973 to place 100% of Chrysler's catalyst requirements with UOP. The documents provided us for the period September 1972 to March 1973 place some stress on the fact that UOP catalysts are cheaper than Engelhard, although they may not perform as well. The difference is variously attributed to a lower UOP precious metal loading, EPR Minutes 1/23/73 (research report), and Engelhard's tighter quality control, EPR Minutes 1/10/73 and 1/23/73.

Catalyst quality aside, there are certain advantages to any manufacturer in having more than one source for such a vital part as a catalyst. A variety of sources spreads the risk of shutdowns and other production difficulties. The Chrysler testimony indicates this was realized. Tr. 3216.

The record is plain,however, that the risk of having only one source was taken because that was the cheaper course. EPR Minutes 11/28/72 ("Mr. Bright commented that from an economic standpoint, Corning-UOP may be the best single source combination . . . .. All things considered, we could decide to risk the single source situation.") (emphasis supplied). He testified to the same effect at the hearing. Tr. 1163.

The amount saved per car by this choice (on the basis of two catalysts to a car) was apparently about $7 a car on the 40% of Chrysler production for which the choice of a supplier other than UOP was still considered open at that time. Tr. 3213, Ex. P-52, C. Doc. Vol. I.

Senator MUSKIE. Before the Administrator delivers his statement, I would like to place these hearings in perspective.

On June 24, 1964, an auto industry spokesman made the following statement to this subcommittee:

> The industry believes that maximum progress can be made in communities, or States, or areas, by:
>
> (a) thorough evaluation of community air quality.
>
> (b) careful evaluation of the magnitude of emissions from each source.
>
> (c) control of emissions by establishment of performance standards rather than design standards.
>
> (d) establishment of a maintenance and surveillance program in conjunction with required source controls . . .
>
> Effective progress can be made only when the specifics of the problem have been defined and are well understood . . . I repeat our pledge to work unstintingly on this problem in the public interest.

In 1970, 6 years later—after nearly 15 years of developing information on community air quality in the public health service:

—after more than 5 years of careful evaluation of the relationship of auto pollution to air quality;

—after 5 years of experience with limited Federal authority to regulate motor vehicle emissions;

—after 3 years of experience with national motor vehicle emission controls; and

—more than 1 year after the auto industry had agreed at the White House to achieve clean car goals by 1980, the Congress passed the Clean Air Act of 1970 which accelerated the deadlines for production of automobiles which would permit achievement of clean, healthful air in our Nation's cities.

Now, in 1973, we are told that those deadlines cannot be met. In most cases the auto industry argues that they cannot produce and guarantee cars which comply with auto emission standards set forth in the law. And, they argue that even if they could, those standards are not necessary.

I want to know why not. I want to know what the industry has done in the past 3 years. I want a public explanation from the industry for the course they have chosen, a course that has not been altered since 1969.

I want to know what the industry is going to do in the coming year to overcome past failures.

I want to know what commitment the auto industry is willing to make to the American people. And, I intend to challenge the assumptions on which the industry's failures have been based.

These hearings are the beginning of the investigation of that failure. I look forward to whatever enlightenment is available.

I think maybe what I have tried to say is better said in an editorial which appeared in the Wall Street Journal on April 13.

Without objection, I will put the whole editorial in the record, but I would like to read these two paragraphs:

> Detroit could strike a more positive posture by squarely confronting the questions raised by Senator Muskie. What is the industry willing to commit itself to?
>
> When will it commit itself to do it? And what guarantees is it willing to give the public?

The auto makers, after all, are in no position to make credible presentations on the nation's health requirements. They should not even try. It is only when the public senses the manufacturers have accepted public policy as good citizens, and have pulled all the stops in an attempt to meet it, that they will have public support should they stumble.

[The editorial referred to follows:]

[From the Wall Street Journal, April 13, 1973]

A Matter of Emphasis

Now that Detroit has the extra year it sought in meeting the 1975 air-emission standards, it is embarking on a campaign to persuade Congress to roll back those standards as set in the Clean Air Act of 1970. While we applaud the decision by the Environmental Protection Agency, we have our doubts about the automakers' reaction.

Not that we think those standards should be thought of as being etched in stone. On the contrary, we're pleased that EPA Administrator William Ruckelshaus has asked Congress to consider a possible relaxation of the strict limit on nitrogen oxides now set for 1976. A number of eminent California pollution experts have all along believed Congress went overboard in setting the standards, and even a fractional lowering of them might save billions of dollars with no penalty to the public health.

Rather, our doubts about Detroit's apparent decision to mobilize its considerable influence in a political attack on the standards have to do with the matter of emphasis. While it is obviously to everyone's benefit that the standards, be reevaluated upon the presentation of fresh data, this should not be Detroit's primary focus. Instead, it should be mobilizing to meet the existing standards as set by EPA and the Congress, and give every appearance of doing so.

Why? Insofar as we can gauge the public mood, the EPA decision was a popular one—Ralph Nader notwithstanding. But this is not because the public is relieved to see the dollar costs of the higher standards put off for a year; it's that the automakers genuinely appeared to run out of time in their drive to meet the standards with clean, fuel-efficient, drivable vehicles.

Having been given a year's grace, the manufacturers above all else must demonstrate good faith. They can not do so by swarming over Capitol Hill, taking full-page advertisements, and having vice presidents fan out over the countryside making speeches denouncing the standards. We would suggest they leave that issue to Mr. Ruckelshaus' EPA technicians, perhaps the National Academy of Sciences, and Congress.

Detroit could strike a more positive posture by squarely confronting the questions raised by Sen. Muskie: What is the industry willing to commit itself to do? When will it commit itself to do it? And what guarantees is it willing to give the public?

The automakers, after all, are in no position to make credible presentations on the nation's health requirements. They should not even try. It is only when the public senses the manufacturers have accepted public policy, as good citizens, and have pulled all the stops in an attempt to meet it, that they will have public support should they stumble.

There are, of course, environmental zealots who wish to punish Detroit for past sins even more than they would like clean air. But because they make the loudest, most irritating noises is no reason the automakers should react in kind. The great body of Americans do not want Detroit to suffer, does not expect the impossible, and will make accommodations along the way as long as it feels in its bones that the manufacturers are trying. In that spirit, Americans don't want to be told that something can't be done. They want to know what can be done.

Senator Muskie. It is my pleasure to welcome the Administrator. As I have said many times, I have a great deal of respect for his commitment to the public policy which he is involved in administering, and we look forward to his testimony in the next 2 or 3 days.

I would now like to call on my colleagues, first Senator Randolph, the chairman of the full committee.

OPENING STATEMENT OF HON. JENNINGS RANDOLPH, A U.S. SENATOR FROM THE STATE OF WEST VIRGINIA

Senator RANDOLPH. Thank you, Mr. Chairman.

Administrator Ruckelshaus, I think your decision was a proper one. I believe it was a realistic determination of the role that you had to play under the Clean Air Act, a responsibility that you had to assume. This had been given to you by the provisions of the act, itself. The act of 1970 established the emission production goals for automobiles.

The chairman of our subcommittee, Mr. Muskie, knew they were strict. All members of the Subcommittee on Air and Water Pollution knew that they were strict. Our committee, the Senate and the House, the Congress, knew that they were strict. We felt that these goals, however, were necessary for the protection of public health, and we felt that they were realistically attainable.

We certainly understood that it would not be easy to affect the emission reductions that had been mandated by the law.

As Administrator, you had the authority under the act to delay the implementation of the called-for reductions for 1 year under certain conditions. I do not think of these hearings—as significant and important as they are—as an attempt by the subcommittee or the members of the committee to second-guess what you have done, Administrator Ruckelshaus, in granting a 1-year delay.

The purpose, as I sense it, is to review the rationale that caused you to render your decision and to assess—and this is very important to me—what that decision portends for the future.

As we examine your decision in the context of the efforts that must be made to reduce automobile emissions in 1976, we are faced with the statutory fact that the permissive provision under which you rendered your decision allows for only one, not two, extensions of the deadline.

Now that the extension has been made, as you have made it in a somewhat limited way—I think the granting of it was realistic—there can be no further postponement of the deadline. Emission standards, under the act, must be implemented on 1976 model cars.

When you announced your decision I issued a statement and I ask unanimous consent, Mr. Chairman, that that statement be included at this point in my remarks.

[The statement referred to follows:]

FROM THE OFFICE OF SENATOR JENNINGS RANDOLPH OF WEST VIRGINIA

APRIL 11, 1973

SENATOR RANDOLPH SUPPORTS ADMINISTRATOR RUCKELSHAUS IN TRANSITION DECISION

Senator Jennings Randolph, Chairman of the Senate Committee on Public Works, today issued the following statement:

"The decision announced today by William D. Ruckelshaus, Administrator of the Environmental Protection Agency, is a reasonable interim action on the implementation of the 1975 requirements of the Clean Air Act for automobile emission reductions.

"His schedule for compliance with the Act appears consistent with its provisions and our understanding of the technological ability to meet these requirements by 1975. In making his decision, the Administrator exercised the responsibilities given to him by the Congress.

"I have carefully reviewed Mr. Ruckelshaus' statement and believe it vindicates the action of the Congress as stated in the Clean Air Act.

"His adoption of procedures to obtain a realistically phased compliance with the Act is a proper approach under the existing circumstances.

"This decision was based on extensive hearings conducted by the Administrator. These public examinations provided a thorough review of all issues involved, both of a technical nature and as they relate to the national economy. These are issues that will receive further scrutiny by the Senate Committee on Public Works during its oversight hearings on the implementation of the Clean Air Act.

"The one-year extension for compliance with standards established under the Act is valid only if it encourages further consideration of technologies other than those proposed for use by the American automobile industry. During this period, the pressures of free market competition should accelerate development of both effective catalysts and other emission-reduction technologies. This will be especially important for the production of cars in the years after 1976.

"The decision to study the value of catalysts on a limited scale will be helpful in determining if they are indeed the best way to comply with the Act.

"It is important to remember that the one-year extension is the only one possible under the Act. The extension granted by Administrator Ruckelshaus relieves no one from the responsibility of complying with the established standards by the statutory deadline.

"During the hearings which the Subcommittee on Air and Water Pollution will hold on this subject next week, I intend to explore with the Administrator questions relating to:

—The effect of EPA's action on achieving on schedule health-related ambient air quality standards;

—Additional strategies to achieve health standards which might be considered by EPA, including transportation and used car controls;

—Alternatives to the present catalyst-based systems which do not adversely affect driveability or fuel consumption; and,

—Alternatives to the conventional internal combustion engine that have particular merit for the post-1976 period."

Senator RANDOLPH. Mr. Chairman, I think we would be naive if we failed to recognize that many, many persons have looked at this matter as a conflict between industry and government. They attempted to set the stage—some people thought— for an attempt to weaken the act rather than carry forward the act realistically, as I think you, in this instance, have helped us to do.

Your action, Administrator Ruckelshaus, I believe, reduces that possibility, and, I think, in a sense, vindicates the action of the Congress. The validity of the act has not been weakened.

I believe the validity of the act has actually been strengthened. However, it is important for the Congress, for this subcommittee, as the able chairman said, to examine your decision, Mr. Administrator, and look toward future implementation of the act.

There are several areas where you can help us as we look at the act and at your decision. We do not know what has happened between last year, when you decided against the industry's request to extend the deadline, and now, 12 months later. You gave the extension with certain provisions of flexibility that I have mentioned.

This will be of interest to us.

We know that you held extensive hearings. We realized that you gave very careful thought to what you have done. You considered the technological developments. You looked, perhaps, at the developments in Germany and Japan, in particular, as perhaps encouraging, and apparently give little weight, very frankly to the industry contention at some points—at least, in some companies—regarding developments in this country.

So it is my hope, Mr. Chairman, that the 1-year extension will not weaken the purposes of the act and will not remove responsibility from the automobile manufacturers. But, rather, will encourage future consideration of technologies other than those proposed for use by the automotive industry, itself.

I could make a further comment, but in the interest of time I shall not do so. Instead, Mr. Chairman, without objection I will put my remarks into the record.

I thank you very much.

[The statement referred to follows:]

Statement of Hon. Jennings Randolph, U.S. Senator From the State of West Virginia

The decision announced last week was probably the most difficult Administrator Ruckelshaus has had to make during his tenure as head of the Environmental Protection Agency. It is a decision that was necessary because of the responsibilities entrusted to the Administrator by the Congress.

The Clean Air Act of 1970 established emission reduction goals for automobiles that we knew were strict. Congress felt, however, that these goals were both necessary for the protection of public health and were realistically attainable. We knew it would not be easy to effect the emission reductions mandated by the law. That is why the Administrator was given the authority to delay their implementation for 1 year under certain conditions.

I do not view these hearings as an attempt by the Committee to second-guess Mr. Ruckelshaus on his decision to grant the 1-year delay. Our purpose is to review the rationale of that decision and to assess what it portends for the future. We must examine this decision in the context of the efforts that must be made to reduce automobile emissions in 1976.

The law permits only one extension of the deadline and such an extension, somewhat limited by the Administrator, has been granted. There can be no further postponement of the deadline. Emission standards established under the act must be implemented on 1976 model cars.

When Administrator Ruckelshaus announced his decision last Wednesday, I issued a statement that I felt he had made a proper decision.

We would be naive if we failed to recognize that some persons have viewed the conflict between industry and government on this issue as setting the stage for weakening of the Clean Air Act. The action of the Administrator last week, I believe, significantly reduces that possibility and vindicates the action of the Congress. The validity of the Act has been strengthened.

It is important, though, for the Congress to examine the Administrator's decision and look toward future implementation of the Clean Air Act. There are several areas in which he can enlighten us. It is particularly important that we know what happened between last year when he denied an industry request to extend the deadline and last week when the extension was granted.

The Administrator conducted lengthy hearings earlier this year to establish the basis for the decision. During those hearings there was extensive discussion of the technology by which the mission standards might be obtained. In my mind, the hearings indicated that the American automobile industry is seriously exploring relatively few options in technology. The developments in Germany and Japan in particular seem very encouraging but apparently are given little weight by the industry in this country. I anticipate that the one-year extension will encourage further consideration of technologies other than those proposed for use by the automobile industry. During this period the pressures of free market competition should accelerate development of both effective catalysts and other emission reduction technologies.

During these hearings we will explore the effect of the one-year extension on the total effort to achieve established air quality standards. We must review additional approaches to pollution reduction which might be considered by the Environmental Protection Agency, including transportation and used car controls. The evidence presented during the Administrator's hearings and that gathered by the Committee require that we discuss in some detail emission control systems that are not based on the catalyst concept. In this context we also must consider alternatives to the conventional internal combustion engine that have particular merit for the post-1976 period.

No consideration of automotive technology and the use of cars can be complete without discussing their impact on the nation's energy supply. Currently anticipated technology to reduce emissions is driving fuel consumption up sharply. This is occurring at a time when we face the prospect of widespread fuel shortage. Certainly this fact should ge given the weight it deserves as emission control technologies are developed and accepted. We cannot afford to resolve one serious national problem—automobile pollution—by increasing another—the fuel shortage.

I remain confident that the Congress acted properly when it passed the Clean Air Act of 1970 which was developed by the Committee on Public Works. As its provisions are progressively implemented, there will be a corresponding reduction in air pollution that threatens the health and well-being of many Americans and the communities in which they live. I never felt that achieving the goals of the Act would be easy or without some sacrifice by all segments of society. We have seen that this is so through the anguish exhibited by the automobile industry in recent months.

These hearings are important for the Committee to review the impact of its past activities and to help us assess future courses. I look forward to them as informative and productive exchanges between those of us who write the laws and those who administer them.

Senator MUSKIE. Thank you, Senator Randolph, for that most appropriate statement.

Senator Buckley?

OPENING STATEMENT OF HON. JAMES L. BUCKLEY, U.S. SENATOR FROM THE STATE OF NEW YORK

Senator BUCKLEY. Thank you, Mr. Chairman.

I, too, would like to welcome you, Mr. Ruckelshaus, to these extremely important hearings. I believe that yours is one of the most difficult jobs in Washington today. Certainly, the massive data which you have had to analyze and take into consideration in balancing all factors and in coming up with your particular judgment has been extraordinarily taxing.

I would like to say this: That if you are really to meet your statutory responsibilities, as I believe you have, you have to balance the many legitimate competing interests which are inevitably affected by the business of moving from where we are to where we, as a society, agree we must go. I have long felt that the best test of whether you were doing your proper job is to measure the decibels of complaints on both sides and if they equal one another then you have done your job.

Obviously, over the weekend you have met this test abundantly. I will be listening with great interest to the testimony as it unfolds.

Senator MUSKIE. Senator Domenici?

Senator DOMENICI. I have nothing, Mr. Chairman. Thank you.

Senator MUSKIE. Mr. Ruckelshaus, I understand you have a formal presentation to make, which will be followed by questions. We will recess about 12:30 or sooner.

We will meet again tomorrow morning and again Wednesday morning, if necessary.

We have informally agreed on the division of the subject over the 3 days so we are sure to cover all aspects of the problem.

With that, may I invite you to make your formal statement.

STATEMENT OF HON. WILLIAM D. RUCKELSHAUS, ADMINISTRATOR, ENVIRONMENTAL PROTECTION AGENCY, ACCOMPANIED BY ROBERT SANSOM, ASSISTANT ADMINISTRATOR FOR AIR AND WATER PROGRAMS; GEORGE V. ALLEN, JR., DEPUTY ASSISTANT ADMINISTRATOR FOR GENERAL ENFORCEMENT; AND ERIC STORK, MOBILE SOURCES POLLUTION CONTROL PROGRAM

Mr. RUCKELSHAUS. Mr. Chairman, I am very pleased to accept your invitation of discussing with you and the members of the subcommittee, the Environmental Protection Agency's implementation of the Clean Air Act. With me this morning on my far right is Mr. Robert Sansom, Assistant Administrator for Air and Water Programs; George Allen, Deputy Assistant Administrator for General Enforcement, who chaired most of the hearings on the suspension request. And on my left is Mr. Eric Stork, who is in charge of our Mobile Sources Pollution Control Program. These gentlemen will assist me and the committee in answering any technical questions that you have that need amplification.

In the late summer of 1970, this committee found that the Nation's "air pollution problem is more severe, more pervasive and growing at a more repaid rate than was generally believed." [1] That is a quotation from the Senate report accompanying the Clean Air Act of 1970.

Responding to this finding, the Congress provided the Federal Government with broad powers to arrest and to cut back the Nation's air pollution. Now, less than 2½ years since enactment, the Clean Air Act amendments are, in my judgment proving to be a success. We already see improvements in the air we breathe while further improvements are scheduled for the years ahead as planned Federal, State and local abatement and control actions take effect.

I am not saying that administration of this act has been easy. It hasn't been. There have been numerable problems which is to be expected with any major piece of new legislation. Today, I would like like to discuss with you two of these problems. Specifically, I would like to address both 1975 automobile standards and transportation controls needed to achieve them in some air quality control regions.

1975 STANDARDS

Last Wednesday I announced that I had granted the automobile manufacturers' request for a 1-year suspension of the 1975 motor vehicle emission standards. At that time I also announced interim nationwide standards and more stringent ones for application in the State of California during the 1975 model year. I believe it would be

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[1] Senate Report 91-1196 p. 1.

helpful if I outlined what brought us to this point and how my decision will affect our citizens.

Under the statute emissions of hydrocarbons and carbon monoxide from new automobiles must be reduced 90 percent from those allowed in the 1970 model year. Provision is made to suspend application of these standards for 1 year if I determine that:

1. A suspension is essential to the public interest or the public health and welfare of the United States;
2. All good faith efforts have been made to meet the standards;
3. Applicants have established that an effective control technology is not available in time for compliance; and
4. The National Academy of Sciences study and other information available to me have not demonstrated that the technology is available to meet the standards.

On March 13, 1972, the first automobile manufacturer requested a 1-year extension. This application was followed by applications for suspension by the major U.S. and foreign manufacturers. Subsequently, I denied the manufacturers' request.

On February 10, 1973, the U.S. Court of Appeals for the District of Columbia Circuit remanded the applications of the manufacturers to me for reconsideration. The court felt as I did in making the original decision, that the issue concerning available technology is so complex that it would probably never be free from doubt. Weighing the societal disruption that might result from denial of suspension against the environmental costs of granting suspension, the court concluded that the adverse effects on the public that could result from an erroneous denial of suspension were potentially more serious than the adverse effect on air quality that would result from granting suspension, even if no interim standards for 1975 were prescribed.

Beginning March 12, 1973, over 2 weeks of public hearings were held to reconsider the manufacturers' applications.

There is no question but that the numerical standards fixed in the statute have taken on enormous symbolic importance. To many members of the public, the issue presented was a simple one of standing up to this powerful industry or backing down. I think it was clear to everyone who participated in these lengthy hearings, however, including representatives of public interest organizations, that the problem was infinitely more complex than that.

The difference between the statutory 1975 reductions in hydrocarbons and carbon monoxide emissions and the interim which will be in effect under my decision for the State of California for the model year 1975 will, in our judgment, have no measurable effects on air quality. In setting these interim standards I have attempted without any significant adverse effect on air quality, to avoid the risk of serious anticompetitive effects if certain manufacturers were unable to certify cars at the statutory levels in 1975.

As the court pointed out, if the industry as a whole is unable to certify new cars in numbers sufficient to meet new car demand in 1975, in California or elsewhere, any gain in air quality resulting from achievement of the statutory levels on some cars could be more than offset by slower retirement of older, high-emitting vehicles.

In my judgment the real issue that was presented, on the record before me, was the oxidation catalyst. I believe I had essentially three choices. I could have set interim standards requiring the use of catalysts on all cars nationwide in 1975. I could have set interim standards which did not require any catalysts in 1975. Or I could require the industry to phase in catalysts in 1975, by one mechanism or another, thereby attempting to minimize initial certification and production problems and their potential adverse effect on the public while maintaining the momentum of technological progress by requiring manufacturers to gain production experience preliminary to use of catalysts on all conventional engines in the 1976 model year.

Based on the record before me, I concluded that oxidation catalysts are workable and that this is the technology that must be used if statutory standards are to be met by 1975 or 1976.

The remaining issue before me, therefore, was how to insure that catalyst technology would be effectively implemented on all cars by 1976 in a way that minimized the potential adverse effects on the public that were emphasized by the court.

In my opinion, the public interest dictated that catalysts be phased into use in 1975 by setting standards in California that would require their use on all conventional automobiles sold there in 1975 and further, to set an interim standard for the rest of the Nation that would likely result in some catalysts use on some models nationwide by 1975.

Briefly, I chose to phase in the catalysts because of the potential societal disruption involved in attempting to apply this new technology across all car lines in 1 year. In weighing this potential against the minimal impact on air quality of interim standards established by the decision, I felt it was the better part of wisdom to phase in the catalyst. I frankly believe that if I had overlooked the real risks that were involved in across-the-board introduction in 1 year, I would have been reversed by the court. And, on balance, I think that the court is right in its judgment that the risks should be minimized where this can be done without any significant adverse effect on air quality.

I emphatically do not believe that this decision will adversely affect the momentum of progress toward achieving the 1975 standards. Instead I believe it is part of the evolutionary process toward cleaning up automobile emissions envisoned by the Congress when it passed the Clean Air Act of 1970.

Let me now explain briefly why I have set different interim standards for the State of California than for the rest of the Nation.

I chose California as the logical place in which to initiate the use of catalysts for a number of reasons: California has an especially serious air quality problem; California has experience in leading the Nation in the application of advanced automobile emission control; California is pecularily situated as a result of the geographic distribution of its population away from other States and population centers so that it offers as close an approximation to a separate market of similar size as is available anywhere in the United States; California has requested a waiver for controls that in making the decision, I was able to partially grant; California officials testified at the hearings in a very positive manner and acknowledged the special advantages to the State of a phase in and the unique air quality needs that are characteristic of that area; and the two largest U.S. automobile manufacturers have committed to the phasing in of catalyts in California.

I want to emphasize that my decision is not intended to test unproven technology in the State of California. I believe that catalytic technology is effective and will be required nationwide in 1976 to achieve the statutory levels. New technology has traditionally been introduced initially in the State of California and thereafter in other parts of the country.

I think at this point we might, as citizens, ask the question, what really is the effect of this decision? There is no single or simple answer, but let me as a citizen give a few answers. The decision does not adversely affect air quality in any significant way. It does not add major burdens to States that already have to design and implement transportation controls. But the decision does offer the promise of insuring that efficient and durable automotive emission control technology will be available to the public nationwide by the fall of 1975 and that this technology will make a major contribution in cleaning up the Nation's air.

Mr. Chairman, at this point, I would like to submit for the record a copy of my decision which includes the interim standards I have established.

Senator MUSKIE. Without objection, it will be placed in the record. May I suggest that it be included at the outset of the record so that it will precede your testimony?

Mr. RUCKELSHAUS. Thank you, Mr. Chairman.

TRANSPORTATION CONTROLS

There is, of course, a close relationship between the motor vehicle emission standards and the requirements for transportation control measures to achieve the national ambient air quality standards for carbon monoxide and photochemical oxidants. Currently, 22 States are expected to submit plans to implement the national standards for either carbon monoxide or photochemical oxidants or both in close to 40 air quality regions. These plans were due to be submitted April 15, 1973. Given the complexity of developing such plans, it is likely that some of them will be late in reaching us. The Environmental Protection Agency will be working closely with the States, as we have been over the past several months, to get these plans completed as quickly as possible.

In developing these plans, the States have necessarily assumed that the 1975 motor vehicle emission standards would be implemented on a nationwide basis in accordance with the statutory timetable. Accordingly, my decision to suspend implementation of the statutory standards for 1 year and establish interim standards may mean that some plans will have to be modified in order to provide additional reductions in pollutant emissions from in-use vehicles.

The amount of additional control needed will vary from one region to another depending on factors such as motor vehicle turnover rates and the degree of control provided by the measures already included in the States' plans. But since the interim national standards move us one-half the way to the 1975 standards and the interim California standards move us two-thirds the way, and since they will apply to just one model year, the additional control required to offset the effects of the suspension generally will be small. It is not anticipated that there will be any regions in which the needed additional control, in and of itself, will require implementation of measures such as gasoline rationing.

It is unlikely, of course, that plans submitted on or shortly after April 15, 1973, will incorporate any revisions to provide for additional control. We do not intend to reject such plans, but rather, we will work with the States to determine what revisions are needed and to get them made prior to the August 15, 1973, deadline for the Environmental Protection Agency's promulgation of measures to replace or augment deficient State plans.

In the Los Angeles region, as you know, the Environmental Protection Agency has already proposed a far-reaching transportation control plan, and we recently completed 3 weeks of public hearings on this proposal. Our proposed plan would require extensive gasoline rationing during 6 months of the year, expensive installation of emission control equipment on in-use vehicles, conversion of fleet vehicles to gaseous fuels, and increased control of stationary source pollution.

We are now in the process of reviewing that proposal in light of the comments we have received and in light of the further analyses which the Environmental Protection Agency staff members are performing. These analyses include a thorough review of the basic premise of our proposal—that an 82-percent reduction in vehicle miles traveled during the most severe months is necessary—and of the practicability, effectiveness, and impact of the various alternative ways of achieving whatever degree of reduction is necessary. We are not far enough along with these analyses to have reached any firm conclusions as yet.

It is clear, however, that implementation of our original proposal—or any other combination of measures adequate to ensure attainment of the national air quality standards by 1977—would have significant disruptive effects in the Los Angeles area. And while there may not be any other areas where the air quality problem is quite so severe, it is possible that there are some others in which some disruptive measures may be needed to meet the national standards by 1977. Here again, it is not possible to be definitive until we have had an opportunity to review the States' plans.

Before leaving the subject of transportation control, I want to try to put it into somewhat broader perspective. First transportation control measures are not necessarily a stop-gap. It is quite likely that some types of transportation control measures will be needed in some areas as a long-term measure to ensure continuing maintenance of the national ambient air quality standards; indeed, even with implementation of a 90 percent reduction in carbon monoxide and hydrocarbon emissions from new motor vehicles, we currently expect that about 12 air quality control regions still will need transportation control measures in 1985.

Second, and more importantly, in the long run, transportation control measures need not be disruptive. The term itself is a misnomer, in that it suggests only the application of constraints. There is far more to it than that. What we really should be working toward is transportation improvements, or, in other words, more efficient ways of moving people and goods into, out of, and around our large metropolitan areas. Adequate transportation is essential. Without it, cities cannot exist. Given foresight, careful planning, and broad public participation and cooperation, transportation improvements can serve not only to get us to work and home more quickly and comfortably but also the enhancement of air quality as well as other aspects of the quality of life in urban areas.

Viewed in this perspective, the steps which must be taken during the next months to meet the specific requirements of the Clean Air Act are simply milestones on the road to the development and implementation of long-range plans for making our transportation systems a boon, rather than a burden, for us and our environment.

Mr. Chairman, this concludes my prepared remarks.

As we discussed before the hearing, tomorrow I will present testimony with regard to nitrogent oxides, in addition to other matters than the committee wants to concern itself with. I will be glad to answer any questions.

Senator MUSKIE. Thank you very much, Mr. Ruckelshaus. I would like to suggest for the convenience of the members of the committee who are here and others who may come that we begin, at least, with an initial 10-minute limitation on questioning by each member of the committee, and observe that rule as long as there are several Senators here to ask questions. We hope it will produce a continuity of discussion.

May I begin with one or two what I consider to be key questions?

The editorial in the Wall Street Journal which I put in the record earlier said this in addition to that which I read:

> Now that Detroit has the extra year it sought in meeting the 1975 air emission standards, it is embarking on a campaign to persuade Congress to roll back those standards as set in the Clean Air Act of 1970.

As you know, the standards set in the Clean Air Act were related to the best evidence we had of the health effects of air pollutants attributable to the automobile. All of us, I think, have been besieged with criticism of the automobile industry that the standards were too high, in other words, that the public health did not require standards as strict as those that we set out in the 1970 act. All of us would agree that because of the implications of these standards we should constantly review them.

I wonder whether you could, at this point, give us any information as to whether or not the health basis for the 1970 standards are still sound?

Mr. RUCKELSHAUS. Mr. Chairman, I think there are two kinds of standards that we have to distinguish between in any discussion of the 90 percent reduction in HC, CO and NO_x that are provided for in the statute. One are those standards and the other to the national ambient air quality standards. The primary ambient air quality standard which must be achieved at the very latest by 1977 under terms of the act are based on a statutory mandate to promulgate standards that protect the public health. The sole criteria that I can take into account in setting a primary air quality standard is protection of the public health. We promulgated those standards, pursuant to the act's requirements in April of 1971. There was a 90-day period prior to promulgation in which any of those standards could be questioned by judiciary after April 1971. The sole standard that was questioned was the secondary sulfur dioxide standard.

I think it is fair to say that the three automobile-related standards of carbon monoxide, hydrocarbons and oxides of nitrogen are not without dispute as to their validity—the ambient standard, I am talking about—and this dispute, in my opinion, will continue into the foreseeable future. Because of the continuation of the dispute, I have periodically asked our health effects scientists to reevaluate the basis of the standard. Recently such a re-evaluation was made and completed and a report was issued to me.

I would like, with your permission, to submit for the record some data related to health effects.

Senator MUSKIE. Without objection, it will be.

[The data referred to follows:]

ENVIRONMENTAL PROTECTION AGENCY,
Washington, D.C., April 25, 1973.

Hon. EDMUND S. MUSKIE,
U.S. Senate,
Washington, D.C.

DEAR SENATOR MUSKIE: In your letter of March 15, 1973, you ask for the current views of the Environmental Protection Agency in four areas related to the automotive emission standards prescribed in the 1970 Clean Air Act amendments. Specifically, you ask about:

1. The validity of the health effects data;
2. The validity of the rollback formula which relates emissions to air quality;
3. Current air quality levels in major cities; and
4. The impact of the "California Standards" if applied in that State or nationally.

1. VALIDITY OF THE HEALTH EFFECTS DATA

In discussing the basis upon which EPA sets ambient air quality standards, I think that it is important to recognize that the development of environmental standards are judgmental decisions which reflect consideration of a number of factors which include: (1) the nature of the dose-response curve; (2) the severity of observed effects; and (3) the existence of highly susceptible groups among the general population. Since judgment is involved, and since our knowledge is always less than complete, a margin of safety must be included so that the standards are not inadvertently set at levels which are still associated with adverse effects.

(*a*) *Carbon monoxide*

The national primary ambient air quality standard for carbon monoxide is 10 mg/m^3 (9 ppm) for a maximum 8-hour average and 40 mg/m^3 (35 ppm) for *a maximum one-hour average*, not to be exceeded more than once per year. The most important toxic properties of carbon monoxide stem from its reversible reaction with hemoglobin to form carboxyhemoglobin. The carboxyhemoglobin level is determined by carbon monoxide (CO) concentration in the air, duration of exposure, and level of physical and metabolic activity. Depending on the level of activity, an 8-hour CO concentration of 10 mg/m^3 will result in 1.3 to 1.4 percent carboxyhemoglobin level and a one-hour CO concentration of 40 mg/m^3 will result in a 1.3 to 2.9 percent carboxyhemoglobin level.

Although the scientific basis for the present carbon monoxide air quality standard is far from complete, the most recent research results show that a large number of susceptible individuals with coronary artery disease may suffer impairment of their health at carboxyhemoglobin levels as low as 3 percent. Accordingly, the current standards afford a relatively small margin of safety for these individuals (10 mg/m^3 for 8 hours provides a twofold margin of safety and 40 mg/m^3 for an hour provides less than a 50 percent safety margin with moderate activity). In view of these relatively small margins between present standards and observed health effects, existing standards are not unduly restrictive. On the other hand, the carboxyhemoglobin levels that will result from adherence to the standard are sufficiently close to background that no lowering of the standard is currently recommended.

(*b*) *Photochemical oxidants*

The national primary standard for photochemical oxidants is 160 ug/m³ (0.08 ppm) maximum one-hour concentration not to be exceeded more than once a year. Adverse health effects resulting from oxidant and/or ozone exposures have been consistently observed in both experimental animals and in man at exposures at least as low as 0.20-0.25 ppm and in some instances even lower. In laboratory animals variations in activity, thyroid function, histamine response, nutritional status, preexisting disease and temperature are known to significantly affect response to ozone, sometimes increasing sensitivity by 2-3 fold and more. Some of these same factors, (i.e., activity and preexisting disease) are already known to affect response to oxidant (ozone) in man.

Because of uncertainly regarding the nature of this dose-response relationship at low exposure levels, as well as the many factors already recognized to influence response to oxidants in animals and man, a minimum 2 to 3 fold safety factor between the lowest consistent observed effect level (0.20-0.25 ppm) and any standard is indicated. Further, any standard above 0.10 ppm would probably not completely protect against eye irritation symptoms. Though perhaps not a significant health problem, per se, eye irritation is still one of the most frequent air pollution complaints.

(*c*) *Hydrocarbons*

The hydrocarbon standard is 160 ug/m³ for three hours (6-9 AM) not to be exceeded more than once a year. Unlike other pollutants, the air quality standard for hydrocarbons is not based directly on health effects. The hydrocarbon standard is based solely on the responsibility of hydrocarbons for formation of photochemical oxidant for which there is a health related standard.

The hydrocarbon standard was established by quantifying the hydrocarbon-oxidant relationship for the purpose of obtaining a numerical hydrocarbon ambient air level consistent with the oxidant standard. The oxidant hydrocarbon relationship used by EPA is based mainly on a study of aerometric data taken in a number of USA cities. Through examination of these data and other materials, a numerical value of 0.24 ppm was derived for the hydrocarbon standard consistent with the oxidant standard of 0.08 ppm. It should be noted, however, that the hydrocarbon level of .24 ppm is subject to some uncertainty due to our inability to accurately measure lower hydrocarbon concentrations. Thus, though enough data points are available to associate the oxidant level of .08 ppm with 0.24 ppm of hydrocarbon, this does not necessarily exclude the possibility that 0.08 ppm of oxidant is associated also with less than 0.24 ppm of hydrocarbon.

(*d*) *Nitrogen Dioxide*

The nitrogen dioxide primary standard is 100 ug/m³ (0.05 ppm) annual arithmetic mean. This standard was based upon the Chattanooga School Children studies in 1968 and 1969. The methods used in these studies to monitor exposures (Jacobs-Hochheiser Technique) have since been demonstrated as unreliable for general use. A reevaluation of the study using other measurement methodologies (Griess-Saltzman) has been undertaken. The preliminary conclusions from this reevaluation suggest that effects were caused at a somewhat higher level of NO_2 than measured in the original study by the Jacobs-Hochheiser method. Although the standard as such may be open to some question, these differences are all in a direction which indicates that the present standard does adequately protect the public health. In addition, the possibility that adverse health effects may be associated with short term peaks requires further reevaluation. We feel that no change in the present ambient NO_2 standard is prudent until a thorough health effects reevaluation can be completed using improved NO_2 measurement techniques.

2. THE VALIDITY OF THE ROLLBACK FORMULA

Rollback calculations were made in 1970 to determine the degree of emission reduction required to attain ambient air quality standards. These analyses used a worst case approach and dealt with the highest measured levels of CO (Chicago); Oxidant (Los Angeles) and Nitrogen Dioxide (New York). The analysis also assumed that all emitters of a given pollutant would be rolled back proportionally. On the basis of this analysis, order of magnitude automotive emission limitations were derived assuming 1985 as the air quality attainment date.

Several changes in these assumptions have been made to determine the impact of various levels of motor vehicle control on air quality standards.

a. Recognizing that all emitting sources cannot be reduced proportionally, more realistic estimates of reductions possible from various categories of sources were made.

b. Weighting factors were introduced to take into account spatial distribution of sources and the height above ground of their emissions;

c. Since the worst case approach using the highest measured air quality values may reflect unusual situations, second worst case values were used in making the analyses;

d. Rather than using a uniform growth rate for all categories, a variable growth rate depending on the emitting source was employed;

e. Provision was made for the introduction of new technology and the attrition of old sources.

The results of this reanalysis are discussed in the portion of this letter dealing with the "California Standards".

3. AMBIENT AIR QUALITY

I have attached to this letter a tabulation (Table I) of the best assessment of the air quality data currently available to us with respect to the ambient levels of carbon monoxide and photochemical oxidant in those air quality control regions requiring some measure of transportation control. Hydrocarbons are not generally measured since, as I mentioned earlier, the degree of hydrocarbon control required is a function of the oxidant levels and the hydrocarbon-oxidant relationship. Historically neither carbon monoxide nor oxidant have been measured in a large number of areas. The classification of regions for purposes of implementation plan development required the conduct of a special study by EPA in the summer of 1971 to obtain data on oxidant and carbon monoxide levels. Twenty-nine regions exceeded the carbon monoxide standards and 54 exceeded the oxidant standard. As you can see from the table, 26 regions which exceed the carbon monoxide 8-hour standard and 30 which exceed the one-hour oxidant standard will require some degree of transportation control. Sixteen regions are listed for both CO and oxidants. The 39 regions listed represent the major problem areas with respect to motor vehicle-related pollutants.

Subsequent to the classification of 47 air quality control regions as priority one for nitrogen dioxide, we discovered a major problem with the Federal Reference Method (FRM) measurement methodology upon which the regional classification was based. The FRM over-estimated low NO_2 concentrations, underestimated high concentrations and was affected by positive interferences from nitric oxides (NO) present in the ambient air. We have engaged in an extensive reevaluation of the nature of the NO ambient air quality problem which included the operation of sampling stations using other measurement methods over the past year. Based upon this reevaluation, we have concluded that only two air quality control regions (Los Angeles and Chicago) should be classified as priority one. Of these, stringent control is required only for Los Angeles.

4. AIR QUALITY IMPACT OF CALIFORNIA STANDARDS

The following indicates the relationship of the California standards to the 1975–76 emission standards mandated in the Clean Air Act:

[In gm/mile]

	California	Federal 1975–76
Hydrocarbons	0.89	0.41
Carbon monoxide	17.4	3.4
Nitrogen oxides	1.55	.4

A comparison of the impact of the California standard and the Federal standards has been made using the modified rollback approach previously discussed. For comparability with previous analyses, the year 1985 has been chosen since, assuming a ten-year turnover in light duty vehicles, any 1975 standard would have its maximum impact at that time.

For carbon monoxide of the 26 regions currently above the air quality standard and requiring transportation control, five regions would meet the standard with present CO standards; eight would meet it with the California standard and 23 with the 1975 Federal emission standard. Of the four regions in California, only one would meet the ambient air quality requirement using the "California Standard" whereas all four would with the Federal 1975 emission standard.

For Oxidants of the 30 regions currently exceeding the standard and requiring transportation control 13 would achieve the required air quality in 1985 if the current emission limits were continued; 18 would attain ambient air quality standards using the "California Standards" and 20 would meet air quality requirements with the 1975 Federal automotive emission standards. No California region would meet the standard under either approach.

Two conclusions are evident from the preceding comparison:

(1) The main difference in the impact of the California standards when compared to the Federal is in Carbon Monoxide; and,

(2) The problem of achieving the ambient air quality standard for Oxidants is more difficult than for CO.

A similar analysis has not been made for Nitrogen Dioxide since, as previously noted, a major NO_2 control problem exists only in Los Angeles.

The analysis as to the achievability of standards assumes only the imposition of emission controls and does not consider the emission reductions associated with various transportation control alternatives. The regions chosen for analysis are those required to submit transportation control measures to achieve air quality. To achieve ambient air quality standards in 1985 some 12 regions would need to impose transportation controls even with the 1975 Federal auto emission standards. To achieve these goals without transportation plans the degree of reduction from 1970 emissions for carbon monoxide from light duty vehicles would have to be in the 96–98% range for the two worst case regions, Portland and Phoenix. (North Alaska is a special case whose high winter time stationary source emissions overwhelm mobile sources and 100% elimination of light duty vehicle emissions would not provide for standard achievement.) In the case of hydrocarbons ten regions would not meet the oxidant ambient air quality standards without the continued imposition of transportation control regardless of the reduction in emissions from light duty vehicles.

I think it is important to recognize that roll back analysis, even using more the realistic assumptions, is at best an imperfect tool. There is no known precise technique to estimate the specific automobile emission requirements related to air quality; however, I think that roll back does permit some generally valid order of magnitude estimates of the relation of emitting sources to air quality change. In recognition of the imperfections inherent in roll back type analysis we are working to develop more precise analytic tools in modelling air quality-emission relationships. Our study currently underway in St. Louis should materially improve our ability to make these analyses.

Sincerely yours,

WILLAIM D. RUCKELSHAUS,
Administrator.

Enclosure.

TABLE I.—AQCR AIR QUALITY DATA

AQCR No.	AQCR name	Priority I		Carbon monoxide (8 hr)				Oxidant (1 hr)			
		CO	Ox	Conc. ppm	Data source	Year	Value	Conc. ppm	Data source	Year	Value
004	Birmingham	X	X	14	SIP	1971	1	0.13	SIP	1971	1
005	Mobile-Pensacola		X					.10	SIP	1971	1
009	N Alaska	X		41	SIP	1971	1				
013	Clark-Mohave	X	X	16	SIP	1971	1	.19	SIP	1971	2
015	Phoenix-Tuscon	X	X	42	TR	1969	1	.15	SIP	1969	1
024	Los Angeles	X	X	41	SIP	1971	2	.62	TR	1970	1
028	Sacramento Valley	X	X	22	SIP	1971	1	.24	SIP	1971	1
029	San Diego	X	X	16	SIP	1970	1	.26	SIP	1970	2
030	San Francisco	X	X	23	CALIF	1971	2	.30	SIP	1971	1
031	San Joaquin	X	X	15	SIP	1970	2	.20	SIP	1970	2
033	S. E Desert		X					.22	SIP	1970	2
036	Denver	X	X	25	TR	1971	2	.18	TR	1971	2
042	Hartford-New Haven	X		12	SIP	1971	1				
043	NY-NJ-Conn.	X	X	32	TR	1971	2	.18	SIP	1971	2
045	Philadelphia	X	X	20	TR	1971	2	.14	S	1971	2
047	National Capitol	X	X	20	SIP	1971	2	.16	SIP	1971	2
062	E. Wash-N. Idaho	X		19	TR	1971	1				

TABLE I.—AQCR AIR QUALITY DATA—Continued

		Priority I		Carbon monoxide (8 hr)				Oxidant (1 hr)			
AQCR No.	AQCR name	CO	Ox	Conc. ppm	Data source	Year	Value	Conc. ppm	Data source	Year	Value
067	Chicago	X		22	S	1971	2				
079	Cincinnati		X					0.13	S		2
080	Indianapolis	X	X	15	SIP	1971	2	.14	SU	1971	2
094	Kansas City	X		15	SIP	1971	1				
106	S. Louisiana-S.E. Texas		X					.13	SU		2
115	Baltimore	X		21	SIP	1971	2				
119	Boston	X	X	17	TR	1971	2	.20	SIP	1972	2
124	Toledo		X					.14	SU		2
131	Minn.-St. Paul	X		22	TR	1971	2				
153	El Paso-Las Cruces		X					.13	SIP	1971	2
158	Central New York	X		15	SIP	1971	2				
160	Genesse-Finger Lake		X					.15	SIP	1971	2
173	Dayton		X					.18	TR	1971	2
193	Portland	X	X	22	SIP		2	.14	SIP		1
197	S. W. Pennsylvania	X	X	21	SIP	1971	2	.16	SIP	1971	2
212	Austin-Waco		X					.11	SIP	1971	2
214	Corpus-Christi		X					.19	SU		2
215	Dallas-Ft. Worth		X					.13	SIP	1971	2
216	Houston-Galveston		X					.32	TR		2
217	San Antonio		X					.15	SIP	1971	2
220	Wasatch Front	X		22	TR	1970	2				
229	Puget Sound	X	X	20	TR	1972	2	.16	SIP	1970	1

DATA SOURCE

SIP: State Implementation Plan.
S: SAROAD.
SU: Summer Study.
TR: Transportation Control Plan.
CALIF: Quarterly State Reports.
Value: 1—Highest Conc. Measured. 2—Second Highest Conc. Measured.

Mr. Ruckelshaus. I think, in general, the report supports the health basis for our ambient air quality standards. Again, I would like to emphasize that that does not mean that reasonable men and men with credentials very similar to the credentials possessed by our health effects experts wouldn't disagree on one side or the other. There are some who say they are too stringent; there are others who say they are not stringent enough. As a lawyer and not as a medical expert, and as a public servant, my best estmate is that this dispute will continue into the future. I think, in general, what we found is that as we do more research on the health effects of the various pollutants with which we deal, we find health effects at ever lower levels of those pollutants in the ambient air. Again, I am advised by our health experts that is what you might expect. As we refine our ability to judge not only the impact of a given pollutant but the synergistic impact of that pollutant when combined with others in the ambient air, we find more health effects. It could be that we find with some of these pollutants the same kind of analysis that we find with radiation. That is that there is almost no threshold below which we find no health effect. At almost any level of these pollutants in the ambient air results in some adverse health effect to some segment of the population. I think it is well for this committee to keep in mind that the Clean Air Act mandates in effect, a zero health risk standard. In setting these standards, as we get ever lower in our findings on health effects and as those standards are driven down, there is, again, a tendency for there to be a greater economic and social impact on the rest of the society.

I would say in summary, as a generalization, Mr. Chairman, that we do believe that the ambient air quality standards that we have set, with the possible exception of the nitrogen oxides, which we will discuss tomorrow at greater length, are sound, that they are without question subject to criticism simply because all the evidence that would be available after 15 years of research is not here yet. But, again, based on the present state of our knowledge, we see no reason to change them.

Senator MUSKIE. So that the decision that you announced last week was not based in any way upon a change in your position as to the health basis of the 1970 standards?

Mr. RUCKELSHAUS. No; it is not.

Again, in my testimony, where I indicated that even after the automotive standards are achieved by 1985, there will be in the neighborhood of some 12 air quality control regions where we may need transportation controls in order to achieve the ambient levels of air quality necessary to protect the public health.

Senator MUSKIE. The standards that were written in the 1970 act, as I understand it, were the same as the standards that had been agreed to by the industry for achievement in 1980, pursuant to a meeting at the White House in 1969. Am I correct in that assumption?

Mr. RUCKELSHAUS. I am not familiar with that meeting, Mr. Chairman. I was not in my present position then. It is my understanding that there was a general agreement because of the paper prepared by Dr. Barth that resulted in standards that were eventually written into law, a general agreement with the industry that this 90 percent reduction would be set as a technological development goal for 1980.

Mr. Stork may know more about this than I do. He was involved.

Mr. STORK. As Administrator Ruckelshaus indicated, and as I recall, Senator Muskie, in the spring of 1970 there set research goals for 1980, and there was an agreement on these numbers as research goals but not as standards.

Senator MUSKIE. So there was not a commitment to these goals for 1980?

Mr. STORK. As I recall that, yes, sir. Your statement is correct, there was not a commitment to meet them but to seek to achieve them.

Senator MUSKIE. I understand from our informal discussion before the hearing started that your health officer or your health expert will be available to testify more fully on this health question maybe tomorrow or the next day?

Mr. RUCKELSHAUS. Yes, Mr. Chairman. We will make him available or any group from the agency available at the committee's pleasure. I think it might be well to elicit the people in our agency who are experts as to what they have to say about these health standards.

Senator MUSKIE. My first 10 minutes are up. I will yield to Senator Buckley.

Senator BUCKLEY. Thank you, Mr. Chairman.

I would like, if I may, to direct my questions to the impact of your decision in a couple of areas.

As the effectiveness of the 1975 use of catalysts on California cars will depend on the general availability of leadfree gasoline, what would you describe to be the progress of the oil industry in achieving a position where it will be able to assure the availability of leadfree gasoline in California in all stations in 18 months' time?

Mr. RUCKELSHAUS. As you know, Senator Buckley, we published regulations a few months ago requiring the general availability of leadfree gasoline across the Nation by mid-1974 when the first 1975 automobiles will start coming off the assembly line. We did this because we felt at that point that the catalyst would be, if not in general use, at least in sufficient use and without no lead gasoline the catalysts would be poisoned and their effectiveness destroyed. It was our best judgment then, and it remains our best judgment, based on testimony from the petroleum industry that they will be able to make generally available one brand of leadfree gasoline by the deadline necessary in order to protect the catalyst.

Senator BUCKLEY. On page 42 of your decision you state that if the auto companies had begun early in 1971 to develop the capability to produce other kinds of engines "large numbers of 1975 automobiles could probably achieve the statutory standards."

Would you please relate that statement to a finding of good faith effort by the automakers?

Mr. RUCKELSHAUS. Senator, back in 1971, when it first was obvious to the automotive industry that they were going to have to achieve these standards by 1975 or 1976, it was necessary for them to make a judgment as to what kind of technology they were going to use in order to meet the statutory deadline. Their claim has been consistent, that because of the 1975 deadline they were, in effect, forced to attempt to develop technology to clean up the present conventional internal combustion engine. Their best judgment at that time was, in most companies though not all and it still remains, that the sole available mechanism for achieving that clean-up is the catalytic converter. They chose then to attempt to continue to develop and perfect the catalytic converter as the best mechanism for achieving the standards. Had they made a decision at that point to shift to an alternative technology, whether it is diesel or the Honda system or some other, it is entirely possible that they could have, by 1975, phased in these alternative technologies to a much larger extent than they are now prepared to do. I do not mean to imply in that statement on page 42 that, therefore, they could have applied this alternative technology on all of their car lines to meet the basic demand by 1975.

So there is some question remaining in my mind as to whether this means technology would have been available by 1975 in meeting the statute. At the same time, in my own mind I think you must distinguish on the issue of good faith between a good faith judgment and a bad business judgment as to what should be done. That is a fine line and a subjective kind of determination.

At this point, given the testimony of some of the automotive companies, I think the jury is still out as to whether it was even bad business judgment to have chosen the technological direction that they did, much less bad faith, because it is possible that, as some within the domestic automobile industry will testify, that the catalytic converter is a superior technology to the other technologies at this point in time, this is particularly true in the case of Honda, which seems to be getting higher marks from many independent automotive engineers.

Senator BUCKLEY. I appreciate your feeling that perhaps it was in the light of what was currently available the proper direction in which to go. Of course, the National Academy of Sciences, in a report submitted by its Committee on Motor Vehicle Emissions does point to what it feels to be significant advantages down the line, sometime in the future, which will be available by these alternatives you mentioned in fuel economy, performance, and a few other areas.[1]

In your decision, you state your belief that as a result of competitive marketplace forces American automakers will be pressured by the consumer into ultimately adopting whichever is in fact the most desirable technology.

Given the fact that at the present time the catalytic converters will not be markedly more expensive than the alternatives and given the fact that, as a result of changes in the currency rates, American cars are beginning to get an advantages vis-a-vis the foreign competitors, do you feel that as a practical matter we may not see those market influences in the years immediately ahead?

Mr. RUCKELSHAUS. I don't think so. I think there are a number of factors that have to be considered.

The minority report in the National Academy of Sciences report to us indicated that the only way they could see that alternative technologies would be developed is if we left the standards where they are in the statute and, in effect, the marketplace dictated which was the superior technology.

When I first saw that I was not at all convinced that that was true. At the hearings I asked each of the automotive companies what they were willing to do in the event I were to grant them an extension of time to develop alternative power sources, especially what they would do if I were authorized to grant more than 1 year—suppose I could grant 2, 3, or 4 years; what would you do? They almost universally testified that they would attempt to perfect the technology they were now trying to perfect during that period of time. In the case of one company, they suggested they would use that period of time to go back to Congress and try to convince them that the law was erroneous. I pointed out I had no authority under the statute to grant an extension for that purpose.

I concluded at the end of the hearing that assuming, as the chairman's question implied at the beginning, that it is necessary to achieve these levels of emission reduction in order to protect the public health, the only way in which we are effectively going to get alternative technology developed is to keep those standards or to push them forward where it is necessary to achieve in the public interest, protection of the public health, and let the marketplace dictate which is the superior technology. I think that in the case of the problems resulting from the devaluation of the dollar, even that will not have much of an impact on the consumer's ultimate choice. If the price of gasoline rises, as many have predicted it will, it may well be that fuel economy becomes a very important consideration in dictating consumer choice. If an alternative technology is able to be advertised as superior in performance, superior in full economy, and superior in performance, superior in full economy,

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[1] The report of the National Academy of Sciences may be found in the appendix, p. 193.

and superior in many other ways to what is being offered either by domestic or foreign manufacturers, just as in the case af smaller cars coming from Europe in the 1960's, I think this is more likely to result in alternative technology than anything the Government could do. I think the Government's obligation should be to set a performance standard that is necessary to protect the public health in as reasonable a way as possible and let the public jury decide the question as to which technology is superior.

Senator BUCKLEY. I am afraid my 10 minutes are up. I will continue this at another time.

Senator MUSKIE. Senator Randolph?

Senator RANDOLPH. Thank you, Mr. Chairman.

Mr. Administrator, I want to explore with you very briefly what will be the effect of extension of vehicle emission standards for 1975. Particularly, I am interested in the effect of your action on achieving the primary ambient air quality standards, those levels necessary to protect public health, on the statutory schedule.

I understand that some States have been relying on the Federal 1975 new car emission standards as the principal means of achieving the related ambient air quality standards.

Will additional transportation controls, than are now planned, be necessary to solve the air pollution health problems in these cities?

Mr. RUCKELSHAUS. Senator Randolph, I discussed at some length in my opening statement the impact on transportation controls, which is what your three questions, I think, relate to.

Senator RANDOLPH. They really go to health standards.

Mr. RUCKELSHAUS. It is necessary under the terms of the Clean Air Act for the States to submit to us transportation controls in order to achieve the ambient or health related standards if they can't get all the way there through the Federal motor vehicle emission control regulations. The effect of the decision, in our estimation, will be minimal on the achievement of the primary or health related ambient standards by the statutory deadline. We do not believe that it will be necessary for the States to submit any drastic changes in their transportation control strategy because of this decision. These transportation plans were due the 15th of April under a court order here in the District of Columbia. Obviously it will be impossible for the States, in the limited time between the decision and the date for the plans to be submitted to take into account in those plans the impact of this decision. What we intend to do is to work very closely with the States to attempt to take into account the impact of the decision on their transportation controls and come up by the 15th of August, which is the final deadline, again under a court order, for us to come up with a transportation plan that will achieve the ambient standards within the statutory deadline.

I might say there is a varying reaction in the States as to these transportation controls. Some of the reaction results from what must be done in the 1975 1977 framework. It is possible for some air quality control reasons to achieve the ambient air quality standards by 1977 without the imposition of any transportation controls. What some of the States are objecting to is what they believe to be very extensive interim controls which may involve retrofitting on all existing vehicles, between 1975 and 1977, in order to achieve the reduction within the 2-year period.

This is the kind of problem that is difficult for us to address under the present language in the statute, and something, I think, that this committee should give some consideration to.

Senator RANDOLPH. Thank you very much, Mr. Ruckelshaus.

I ask, Mr. Chairman, that at this point the article in the New York Times, which I have read, for Sunday, April 15, called "Most Big Cities May Fail on 1975 Clean Air Deadline" be included.

Senator MUSKIE. Without objection, it will be included at this point in the record.

[The article referred to follows:]

[From the New York Times, April 15, 1973]

MOST BIG CITIES MAY FAIL ON 1975 CLEAN AIR DEADLINE—STUDY REPORTS 38 FACE SPECIAL PROBLEM BECAUSE OF THEIR HEAVY AUTO TRAFFIC—STATES' PLANS ARE DUE TODAY

(By Gladwin Hill)

Most of the nation's big cities, including New York, appear unlikely to be able to meet prescribed Federal standards for clean air by the deadline of May 31, 1975.

Thirty-eight cities in 21 states and the District of Columbia face a special problem because of heavy automobile traffic. Even if all the other sources of air pollution are brought into conformity with the standards—and it is by no means certain that this will happen—these cities will be left with excesses of two pollutants generated by automobiles.

ONLY FEW PLANS READY

The fact that the Environmental Protection Agency on Wednesday granted automobile manufacturers a year's delay in meeting the 1975 deadline for producing nonpolluting vehicles only complicates the problem.

Today is the deadline for the states in which these cities are situated to submit to the Federal agency detailed plans for coping with the problem.

But checks with those cities by The New York Times showed that only a few of the problem areas were prepared to submit "transportation control plans" that appear to meet the requirements.

MEASURES PROPOSED

Even if Detroit could produce nonpolluting cars by the original deadline, the effect in these big cities would be slight because only new cars would be properly equipped. The older models, making up 90 per cent of the auto population, would still be spewing out unacceptable amounts of carbon monoxide and oxidants.

The Clean Air Act of 1970 established Federal limits on six basic air pollutants and set May 31, 1975, as a deadline for them to be met throughout the country. Standards were also set for automobile exhaust emissions, but the states were expected to meet Federal air quality standards regardless of what the auto industry did.

Last year, the Environmental Protection Agency identified the cities that it felt would have the biggest problem meeting the standards and told them that they would have to institute extraordinary measures to bring under control two of the pollutants generated by autos.

Measures suggested by the agency ranged from rationing of gasoline to fitting older automobiles with fume-controlling devices.

Only a few of the local plans that have been submitted call for full compliance by May, 1975. Some do not envision compliance before 1977 or even 1980.

Some states, either in desperation or in disagreement with the Federal agency, did not plan last week to file any plans at all, and others did not plan to file until after the deadline.

The environmental agency had hoped that firm plans would be submitted, but virtually all of those produced are essentially just lists of possible alternative measures, already known to the agency, ranging from a simple expediting of traffic flow to mandatory restrictions on auto travel.

Some tentative city programs involve costs of hundreds of millions of dollars. In one way or another, most of them presage pronounced changes in life patterns in many communities.

DEADLINE JUNE 15

Generally, the plans leave it up to the environment agency to decide which of the measures should be instituted.

The agency is supposed to approve or disapprove of these urban "transportation control plans" by June 15, and, where they are inadequate, to promulgate Federal solutions by Aug. 15.

As things stand, California and some other states will not have their plans on file before the approval deadline.

While Federal officials are making no comments until the plans are in, there is no question that any delays would represent a considerable set-back to the national air cleanup program.

For millions of city residents, delays would mean continued exposure to carbon monoxide and oxidants in concentrations calculated by Federal experts to have potentially adverse effects on public health.

Any areas of the country not in compliance with the Federal air quality standards by May, 1975, as the law now stands, will be liable to Federal court action any time the environment agency thinks public health is endangered.

Seventeen states, including New York, under the Clean Air Act were granted two-year deferments of the 1975 compliance date last year.

DEFERMENTS RESCINDED

However, a Federal court last January rescinded the deferments as having been granted without sufficient proof of need. Federal officials think that any new extensions will be granted only on a very selective basis after cities have implemented all the transportation control measures they can.

All 50 states had to file comprehensive air pollution control plans covering both stationary and mobile smog sources by February, 1972.

The programs of a score of states have been fully approved, and the environment agency is ironing out deficiencies in the others. The big city transportation control plans are part of the over-all plans.

Among the few cities expressing some hope of meeting the 1975 compliance date are Minneapolis and St. Paul and Seattle and Spokane, Wash. Chicago officials say that they can meet the standards with a seven-month extension.

"I think Congress may have to face up to the fact that they were optimistic to think the states could meet the standards in 1975," said Baltimore's acting air quality director, George P. Ferreri.

New York State officials do not foresee compliance in New York and other cities before 1977.

"RETROFITTING" OF CARS

Alexander Rihm Jr., director of the state's air pollution division, said that the Federal standards could be met by 1975 throughout the state only through "retrofitting" of pre-1975 cars with special emission control equipment.

He put the cost to the public at $1-billion and to the state at $350-million.

New Jersey can't submit a plan now, its air pollution chief, William A. Monroe, said, because it is drafting a program for compliance in 1977. The environment agency has called for coordination with pollution levels in New York City by then, "and we don't know what percentage reduction in pollutants is necessary," Mr. Monroe said.

"We're making a full-fledged attempt to meet these standards on a good-faith basis," said Wesley Gilbertson, Pennsylvania's deputy secretary of environmental protection. "But the question of funding is crucial. We'll have to rely heavily on Federal funds. It'll be a rough go."

Alabama, Indiana and Texas are in effect contesting the environment agency's calculations.

Alabama is not going to file any plans for its two problem cities, Birmingham and Mobile, on the ground that "new cars will solve the problem by 1976, and there's no use undertaking a terribly expensive plan that will be good for only one year."

TEXAS WILL NOT FILE

In Texas, which has 10 cities in seven air basins in the problem category, the state air pollution board decided Tuesday to submit no plans on the ground that they would yield "only minor and short-term reductions in air pollution."

Federal officials have reported that Houston has problems second only to those of Los Angeles, and that compliance by 1975 might be achievable only by such stringent measures as gasoline rationing.

Indiana contends that, on the basis of previously unreported air quality measurements, Indianapolis is meeting the 1975 air quality standards already.

California says that transportation controls in El Centro would be pointless because air pollution in the surrounding "southeast desert air basin" comes from adjacent areas rather than from the city.

Alaska has already informed the Federal officials it cannot devise any program for Fairbanks. Although the population is only 24,000, temperature differentials in low altitude air strata often trap concentrations of carbon monoxide several times the Federal limit, especially in cold weather when motorists keep their engine running constantly.

A 70 per cent reduction in auto traffic would be necessary to meet the Federal requirement.

In many of the states checked in the survey, officials said that their planning had been disrupted because it had been based on the invalidated 1977 target date.

PROBLEM MORE DIFFICULT

Last week's decision giving the car manufacturers until 1976 to achieve 1975 emission limits will make it that much more difficult for the cities to achieve compliance even by 1977. The law does not provide for compliance deferments beyond that date.

In many cases, states appear to have disregarded the spirit if not the letter of the law, which called for public hearings on the transportation plans. Some states have scheduled no hearings, and some—New York City did this too—held them too close to the submission deadline to affect the plans. Hearings were often poorly attended.

Ordinary citizens either didn't realize what was going on or didn't realize the implications," Baltimore's George Ferreri said. "I'm afraid they're going to wake up some day and say, 'What have they done to me?' "

The Federal air quality standards cover six basic pollutants—hydrocarbons, particulates, exides of sulphur and nitrogen, carbon monoxide and photochemical oxidants. Cars are the principal sources of monoxide and oxidants.

Cars, along with stationary sources, are also a source of oxides of nitrogen, but Federal controls on automotive sources of oxides of nitrogen do not start until 1976.

Specialists of the Federal environment agency, analyzing local air pollution loads across the country, originally calculated that only about 26 cities in 17 states would have difficulty in meeting prescribed air quality standards by 1977 without instituting transportation controls.

MORE CITIES ON LIST

The Federal court's reinstatement of the 1975 deadline put 11 more cities in five states in the same bind. Another urban area, Rome-Syracuse in New York, was added to the list only a few days ago.

For several years the environment agency has been counseling cities on a wide range of possible measures to reduce their car fumes.

These include expediting traffic (to lessen stop-and-go driving); decreasing car use and vehicle concentrations by improved public transit, car pools, staggered working hours, central-city parking restrictions and surcharges; auto-free zones, and gasoline rationing.

Also, improving fume controls by periodic car inspections, "retrofitting" of older cars with fume controls, conversion of fleet vehicles to natural gas and limiting car registrations.

Various combinations of these measures make up most of the transportation control plans as they now stand.

In the case of Los Angeles, which has the worst auto smog problem, an environmental lawsuit forced the environmental agency in January to prescribe gasoline rationing as the only certain way to achieve a necessary 82 per cent reduction in car-miles by 1975.

This was conceded to be impractical, and the agency is now studying other remedies. Local officials see little hope of qualifying before 1980.

Plaguing the state plans are many unresolved jurisdictional problem. While the states rather than the cities are answerable to the environment agency, some states say that they do not have the authority to regulate traffic in cities. Conversely, some cities disclaim the authority.

Several problem areas involve multiple state jurisdictions. One is the Kansas City, Mo., and Kansas City, Kans.

Another is Washington, D.C. where the air basin also involves parts of Maryland and Virginia, and officials say that three-way concurrence may not be a simple matter.

Similarly, New York City needs coordinated regulations with portions of New Jersey and Connecticut that account for much of its commuter traffic.

SMOG-TROUBLED CITIES— Their Transportation Control Plans

Under the 1970 Clean Air Act, 38 cities in 21 states and the District of Columbia with exceptional automobile smog problems were given until April 15 to submit to the Environmental Protection Agency programs for reducing auto carbon monoxide and oxidant emissions. The table outlines the status of these plans.

Plan Submission .... Prospect of compliance with April 15 deadline.
Compliance Prospect .... Date when locality expects to meet air quality standards the law prescribed for May 31, 1975.
Inspection .... A system of mandatory inspection of vehicles, annually or more often, to see if their emissions are within prescribed limits.
Traffic Controls .... Special measures to speed up traffic flows, or restrict free movement of cars.
Transit .... Measures to institute or expand public transit systems or to increase their use.
Retrofit .... Mandatory installation of special fume control devices on pre-1975 cars.
Parking .... Special restrictions on parking to discourage downtown driving.

● Plan under consideration
? Uncertain

State	City	Plan submission	Compliance Prospect	Inspection	Traffic Controls	Transit	Retrofit	Parking	Other
				Measures under consideration					
ALABAMA		No plans							
	Birmingham				No plans				
	Mobile				No plans				
ALASKA	Fairbanks	No plan							
ARIZONA	Phoenix	?	1977	●			●		a.
CALIFORNIA		June							
	Los Angeles	b.	1980 ?	●	●	●	●	●	a.
	Sacramento	No plan	1976-77						
	San Francisco	June	1977 ?						c.
	Fresno	No plan	?						
	El Centro	No plan	?						
	San Diego	June	?	●			●		
COLORADO	Denver	Apr. 15	1977			●			
DIST. OF COLUMBIA	Washington	Apr. 15	?		●	●	●	●	d.
ILLINOIS	Chicago	Apr. 15	1976	●	●			●	
INDIANA	Indianapolis	No plan							
KANSAS	Kansas City	See K.C., Mo.							
LOUISIANA	e.	No plan	?						
MARYLAND	Baltimore	Apr. 15	1977	●	●	●	●		
MASSACHUSETTS	Boston	June	1977		●	●		●	
	Springfield	?	?						
MINNESOTA	Minneapolis	?	1975		●	●	●	●	f.
MISSOURI	Kansas City	Apr. 15	1976					●	
NEW JERSEY	g.	No plan	?						
NEW YORK	New York	Apr. 15	1977	●	●	●	●		
	Rochester	Apr. 15	1977	●	●	●	●		
	Rome - Syracuse	Apr. 15	1977	●	●	●	●		
OHIO	Dayton	Apr. 15	?	●		●			
	Cincinnati	?	?						
	Toledo	?	?						
OREGON	Portland	Apr. 15	?	●	●	●			
PENNSYLVANIA	Philadelphia	Apr. 15	?	●	●	●		●	
	Pittsburgh	Apr. 15	1977		●	●		●	
TEXAS		No plan							
	Austin-Waco		?		No plans				
	Dallas-Ft. Worth		?		No plans				
	Houston-Galveston		?		No plans				
	Corpus Christie		?		No plans				
	San Antonio		?		No plans				
	El Paso		?		No plans				
UTAH	Salt Lake	Apr. 15	1977	●	●	●		●	
WASHINGTON	Seattle	Apr. 15	?	●	●	●	●		h.
	Spokane	Apr. 15	?	●	●	●	●		a.

a. Convert some vehicles to natural gas fuel.
b. EPA is formulating plan.
c. Stagger working hours and convert some vehicles to natural gas.
d. Regulate aircraft idling.
e. Area involved is southern Louisiana—southeast Texas air basin, centering on Beaumont, Texas.
f. Car pooling considered.
g. Area involved is northeastern urban section; New Jersey is to develop special program with New York City.
h. Considering daytime ban on truck delivery.

Mr. RUCKELSHAUS. I might say I, too, have read that article and think it is an excellent discussion of some of the problems resulting from our efforts to implement these transportation controls.

Senator RANDOLPH. It clarifies some of the situations that I was thinking of; namely, where do we go and what do we do?

In your statement, Mr. Administrator, you indicate that the two largest automobile manufacturers in this country; do you speak of them as Ford and General Motors?

Mr. RUCKELSHAUS. Yes.

Senator RANDOLPH. They support the phasing-in process of catalysts in California. That leaves the third of the big three—Chrysler. It has, in effect, and presumably in rather strong language, stated its opposition to this approach. How would you evaluate the argument of Chrysler?

Mr. RUCKELSHAUS. I think it is fair to say, Senator Randolph, that Chrysler doesn't like the catalyst. Again, as the one charged with making the decision as to what is and what is not available technology I have to take into account not only the feeling and convictions of one of the automotive companies as to what is and is not available in effective technology but all of them, in an independent assessment as we can make with our own technical staff of what certain technology will do. In doing that, it was our best determination that the catalyst is available technology, it will work, and that as the two major domestic companies indicated the best way to rule out any production line failures and resultant economic turmoil that they postulate was to phase it in, in California. This had particularly attractiveness to me for the reasons I stated in my statement, plus the one you suggest, that two of the companies indicated they were willing to do that.

Senator RANDOLPH. I thought we ought to draw the difference in approach of the two companies and the third of the large manufacturers.

I do have concern, and I am sure others have—although, as I said at the outset, I believe you made a realistic decision. I feel that very strongly——

Mr. RUCKELSHAUS. Senator, Mr. Allen mentioned, and I may point out, that Chrysler has no alternative suggestion as to how we might meet the standards. Their stated conviction and belief is that it is unnecessary in order to protect the public health to achieve the standard.

Senator RANDOLPH. In fairness to Chrysler, that is a statement I think it is good for you to make and for us to recognize.

I say I am somewhat concerned as we think of 1976, that following this additional year for the phased-in application of catalysts that we might have in effect locked in the catalyst as the long-term solution. I think perhaps you are aware of that feeling. What is your comment?

Mr. RUCKELSHAUS. I think that is entirely possible. It is my understanding that the automotive industry intends to write this investment off in 5 years. I also frankly don't see any alternative as to how it is possible, through law, to impact the private sector so as to develop alternative technologies. There are four, five, or six of them that seem to be coming on, that appear to be promising. That is, short of setting a performance standard that Congress determines or the administration administratively has determined is necessary to protect the public health. I just don't see any other way to do it.

If, in fact, that does lock the domestic industry into a technology that is inferior, as some suggest, again my belief is the quickest way to get out of that technology is through the dictates of the marketplace rather than anything that the Congress can do.

Senator RANDOLPH. I know many of us have been approached; I have been told of the decreased performance and what I would call poor drivability associated with catalyst control systems. In other words, I guess we can just call it less efficient operation. You have heard this, of course?

Mr. RUCKELSHAUS. Yes.

Senator RANDOLPH. And it will be repeated over and over again. I am wondering if the catalyst system could have the effect of being counter-productive. I am not even suggesting that it is; I am only asking a question. And, my question is from the long-term perspective.

Mr. RUCKELSHAUS. Senator, I think it is extremely important that we clarify this point because an awful lot has been written and said about the catalyst and what it does and what it won't do. It is true that in the 1973 automobiles there is a fuel penalty over the uncontrolled present 1968 car. We have published our analysis of what that fuel penalty is. We believe on the average it is 7 percent. That doesn't mean there are not some models where it will be less and some where it will be more, but that is what it is on the average. It is also true, based on the methods by which the automotive companies assess drivability and performance that there are some performance and drivability penalties associated with 1973 automobiles. These are not due to the catalyst. These are due to engine modifications. There are no catalysts on any cars presently offered for sale. And these claimed penalties are due to engine modifications necessary to meet existing standards. There will be additional engine modifications necessary to achieve the 1975 interim nationwide.

Again, there may be some drivability or performance penalties associated with these advanced engine modifications. We do not believe that there is any performance or drivability or fuel penalty of any proportions at all associated with the use of the catalyst in 1975. However if the catalyst is placed on an engine that has all of the other advanced engine modifications associated with what we predict will be on in 1975, we may find some drivability or performance problems or some fuel economy problems. But they won't be due to the catalyst.

General Motors testified at the hearing, and there is also evidence in the record as to the test that Ford has made, that instead of a fuel penalty associated with the 1975 system that General Motors intends to use, including the catalyst, there will be a fuel economy associated with the 1975 system over the 1973 system.

In other words, there will be better fuel mileage.

In addition, some of the tests that Ford has made on their Riverside fleet indicate better performance and better drivability on the proposed 1975 system than for the present system. So much of the attribution of fuel penalty, drivability, and performance problems that have been alleged to be associated with the catalyst which in fact is not the case. Instead, they are associated with some of these advanced engine modifications.

Senator RANDOLPH. I have one final question, Mr. Chairman.

Mr. Ruckelshaus, you have stressed the marketplace. I can see what you are talking about because I remember the quote from your testimony where you say: "The sooner strict standards are adopted the sooner the Honda engine will be able to show its true strength in the marketplace." Is that correct?

Mr. RUCKELSHAUS. Yes.

Senator RANDOLPH. Its true strength.

In a sense, now, perhaps we do not yet know just what that strength would be, is that correct?

Mr. RUCKELSHAUS. Yes; I think that is an important point to make.

Senator RANDOLPH. I would imagine that you would apply this concept to other promising but yet unconventional techniques, would that be true?

Mr. RUCKELSHAUS. Yes, I think that is correct.

Senator RANDOLPH. Assuming that this is true and thinking in terms of the interim standards, as we look toward the future, I think we all realize that the consumer is going to be very much involved because of the heavy investment he is going to make in the catalyst. We know, of course, what that means. If the Honda engine—let's say other engines—are marketable, would the catalysts being called for now be necessary or would they have more strength in the marketplace?

Mr. RUCKELSHAUS. I want to make sure I understand your question.

Senator RANDOLPH. I am talking about the unconventional technologies. You have said that is true. Will not the interim standards require a heavy investment, as I have said, in catalysts before the Honda engine and other alternatives are marketable and thus make the catalyst necessarily more powerful in the marketplace? Maybe that is very involved.

Mr. RUCKELSHAUS. There certainly will be more automobiles offered for sale that have catalytic converters than not in 1976 under the present projections. In that sense they will be more powerful. In the sense that they will be competing against alternative technologies that may have more consumer attraction they may not be as powerful. I think really on this point that jury is out. We don't know what the determination is as yet.

Senator RANDOLPH. That was the point that I desired to make.

I want to close with this comment: You have spoken about the cost of the fuel which might be a reason for less operation of, let's say, the present motor cars or those that will be offered for sale.

I believe, Mr. Chairman, that an even more significant factor will be the shortage of gasoline, itself, the rationing of gasoline, which we will see in great degree in certain areas of this country if not nationwide during the late spring and summer. I feel that this point should be a part of the record here today. This factor may weigh perhaps as heavily or more heavily than the one mentioned by Mr. Ruckelshaus, of cost, which is important.

Senator MUSKIE. Senator Domenici?

Senator DOMENICI. Thank you, Mr. Chairman.

Mr. Ruckelshaus, I have a couple of questions that relate to the impact of your decision on the consumer in this respect: It seems to me that the private sector marketplace competition that you have referred to at various times in your report and in your testimony should be looked at in light of the possibility that your decision will be used 18 months hence as an excuse for a very bad performing automobile.

You have told Senator Randolph that Ford has conducted significant tests, that they are going to make motor modificaions and that the catalyst is going to work. You told us publicly on television that you have a Mercury that works quite well. What independent technical investigation have you at your disposal to verify the contentions of General Motors and Ford that, in fact, the catalyst is probably going to work?

My concern is a very broad one. We could get down the line and find that your agency becomes the goat for society in that you could be the one who said. "Do it" to the public, so to speak. Do you have significant independent investigation as to the catalyst and its functioning next year?

Mr. Ruckelshaus. Senator, I certainly appreciate your concern for our agency, but it would be impossible for me to believe that the intensity of criticism could get any greater between now and 1975 over this decision.

In answer to the first part of your question, will this decision be blamed as the cause of poor performance or drivability or fuel penalties, I think I can say fairly categorically, it will be. The standards as presently adopted have already been blamed for every problem that every automobile seems to have in 1973. Nobody ever produced a lemon in the past. It is all due to the emission standards set by EPA.

There are some performance and drivability problems. It is a more delicate engine now than we had before. There is the start up problem. I am not saying these are things we should discard as though they are of no significance. We have published a study that we made on the fuel penalty associated with the 1973 systems, and have, in fact, sent a copy of that to all Members of the Congress because we received so many inquiries from the public about poor fuel economy from the 1973 automobiles.

In that study we pointed out what other aspects of the automobile caused fuel penalties, including air conditioners, automatic transmissions, and the weight of the automobile.

I think it is very difficult to objectively assess drivability and performance of an automobile. The automotive companies themselves have certain standards by which they attempt to judge whether a car is acceptable in terms of performance and drivability. And they judge their own car models and their engines.

Senator Domenici. Let me ask it this way: Assume that really does not work as well as you are telling us you think it is going to, my question is this: Are we going to point solely to Ford and General Motors and say they told us it would, or are you telling us that you have sufficient independent technical ability to tell us that it most probably will? That is my question.

Mr. Ruckelshaus. I think that is a good question. I am not the only one who says they are going to work. There is a lot of testimony in the hearings. As you might expect, the most intensive testimony that it will work is on behalf of the catalyst manufacturers themselves, who paint a very glowing picture as to how good this technology is.

There is, however, more objective evidence as to its effectiveness. We have independent tests that we have run on the effectiveness of catalysts. It is important to remember that if the catalyst, itself, fails, and it has been called a catastrophic failure and all that, the driver wouldn't even know it. The engine wouldn't run any differently if the catalyst isn't performing up to 100 percent. They have retrofitted catalysts of an earlier generation onto existing police cars in New York City and they have testified to their very high reduction of hydrocarbons and carbon monoxide under fairly extreme driving conditions in New York City. So I think the catalyst will work.

There is some question as to the durability, as to what levels or reduction of pollution it can achieve. But we think it is good technology and will work. This is an independent assessment in addition to other evidence that we have received.

Senator DOMENICI. So that it is your testimony that you have substantial evidence besides that of the companies upon which to base your judgments?

Mr. RUCKELSHAUS. Yes; thereby insuring that I will be blamed if the catalyst doesn't work.

Senator DOMENICI. Now let me ask you about the court decision you referred to a number of times here today.[2]

The act was considered by the court and some things were clarified for you. At least it put down in judicial language some kinds of criteria and standards for you. Is there any need for future legislative clarification at this point, in your opinion, or is the law as it is, plus the court decision, adequate for you to continue on in enforcement of the act?

Mr. RUCKELSHAUS. We believe there may be a need for the Congress to address the nitrogen oxide problem. But as I mentioned, as I have mentioned many times before, including the press conference at which we announced the decision—and we will be bringing that up tomorrow and discussing it with the committee—well, let me make a more general statement about this. There may be a need to give us additional flexibility to address problems such as exist in Los Angeles. However, we want to go through this testimony at the hearings in Los Angeles very carefully in order to determine whether that is necessary. In this statute there were a number of very close congressional restrictions placed on the flexibility in the implementation of the act by whoever the administrator might be of EPA. There is a long history of this. Many of these reasons are justifiable. But when Congress does that, and places those restrictions, I think it is necessary as a general matter for Congress to very carefully and continually review the problems that arise in the implementation of the statute so as to avoid any bad distortions that might occur. It is impossible to foresee 5, 6, or 7 years into the future what the effect might be of a given piece of legislation. From that vantage point I think it is necessary for us to bring to the attention of Congress whenever we see administrative problems occurring where congressional relief might be warranted.

Senator DOMENICI. Along a similar line but not precisely on the same vein, on page 23 of your decision you state that General Motors could meet 1975 standards with at least 93 percent of its vehicles while other companies would have a far lower success rate.

Do you have an explanation of this discrepancy in the success of the various companies?

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[2] The court decision referred to may be found at p. 348 of the appendix.

My question has to do with whether there is anything by way of legislation that we could do that would, in the future, cause such significant discrepancies to be minimized.

Mr. RUCKELSHAUS. I think the discrepancies exist because over the past year it is our best technical assessment that General Motors has made significant progress in developing the catalyst and, therefore, would be able to use the catalyst to achieve these standards on a broader range of their engine families than would the other manufacturers involved.

Again, where you have set a performance standard that is admittedly stringent, this kind of breakdown would be almost inevitable. If you set one low enough so that everybody could achieve it, it is conceivable you are not doing enough to protect the public health, though it is not necessarily true. It is conceivable. Given the stringency of the present standard, it seems to me, it is almost inevitable that someone will be out in front in achieving those standards. This is our best technical judgment of where they stand in that effort.

One of the things that has concerned the automobile industry from the beginning, and I think it is understandable as to why it concerns them, is what happens to the winner of this race. If they are able to develop better technology but in fact it is more expensive, causing poor fuel and drivability and so on, will they be penalized because they have not been able to achieve it? It is a difficult problem to address. That is why we announced back in May 1971 that it appeared to us if one company could achieve it or more than one company for the basic demands for automobiles to be met, we had no recourse but to deny any request for an extension of time. This is a very difficult process, obviously, if somebody can't meet it and the others can. We don't believe the percentages involved here in the decision match that standard because the basic demand would not be met under those percentages.

Senator DOMENICI. I assume your technical people were involved in an ongoing manner with what the three majors were doing by way of experimentation. Is that correct?

Mr. RUCKELSHAUS. Yes; there is a very close relationship between our technical people, primarily in our lab at Ann Arbor, and the technical people in industry as to what they are doing, that is what efforts are being made to achieve standards.

Senator DOMENICI. I have no further questions, Mr. Chairman.

Senator MUSKIE. I think it might be useful and proper to place in this discussion a copy of your study on fuel economy and emission control. Without objection that will be included.[3]

Mr. RUCKELSHAUS. I might also mention that there is a 700-page appendix to this decision that involves the technical assessments and methodology by which we arrive at the numbers in the decision, itself. It is being printed now. We will be glad to submit that for the record, too.

Senator DOMENICI. Could we have that for the committee files, Mr. Chairman?

Senator MUSKIE. Without objection.

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[3] The study referred to may be found in the appendix, p. 414.

Senator RANDOLPH. Mr. Chairman, just this one postscript:

Senator Domenici speaks of the review, the oversight, within this subcommittee. I want the record to reflect that I doubt if there has ever been, Mr. Chairman, a staff of a subcommittee that has kept as closely apprised of what is being done in the Environmental Agency headed by Mr. Ruckelshaus as has our own subcommittee staff on Air and Water Pollution.

I think it has been very, very important that we do this, not that we were attempting to very quickly find fault.

The work of following what you were doing as quickly as possible, and also, Administrator, your coming before us in the subcommittee and talking with us, telling us of the developments, of the problems, I think it is the best procedure in connection with a complex subject of this kind with which you as well as the Members of the Congress must cope.

I think, very frankly, we often have failed in the Congress to have the oversight review hearings that we should have had on many subjects. It is difficult, as the chairman knows, to have the time, really, to prepare for that sort of work.

Our legislative work becomes so heavy that sometimes we can't pull back and take that look that we should at a law that we had formulated and the Congress had approved.

I think increasingly the Senate, not speaking for the House, should have a larger role and establish it within its own system of review and survey of what is done, not looking with the thought that we will find that the agency carrying out the law has subverted the intent of the Congress but hoping that we can work together in the formulation of new legislation and refining the legislation, if necessary, which has been passed.

Your attitude with all of us here has been very frank, very forthright. This has helped us. This has not been a confrontation and it should not be. It is a desire to find, if we can, the answers and to find the best way to help you and you to help us. We are dealing with a subject that goes to the heart of the economic strength of this country, the employment of hundreds of thousands of workers, the production lines, the whole mobility of America. These are not subjects of little consequence.

I think it is very important that what we have been doing we do in greater degree.

I commend you, Chairman Muskie and the members of the subcommittee staff, as well as the full staff of this committee in trying, not so much to ride herd, but to be very close to what is being done. And to work with Mr. Ruckelshaus as he works with us for solutions which will benefit, insofar as possible, the most people in the most realistic way.

Mr. RUCKELSHAUS. I thank you for that statement.

I couldn't agree with you more. What we are dealing with here is of enormous importance. To the absolute extent possible, I think it is important that we keep the staff and you apprised of what problems we are having, precisely, and exactly what potential relief we might need, if any.

It is just too important a matter to get involved in any lack of communication between our agency and this committee.

Senator RANDOLPH. Thank you, sir.

Senator MUSKIE. Mr. Ruckelshaus, I will give myself another 10 minutes and then go around the committee again.

I want to get back to the health question which I raised earlier. I would like to make a couple of observations because I think they are necessary in the light of some of the fairy tales that I have read on this question.

First of all, the health basis for the 1970 act was not some arbitrary standard that this subcommittee created out of whole cloth. The health basis of this act was established in accordance with the best advice and evidence and testimony available to us from the Public Health Service. The Nation's doctors, in other words.

There was understanding, of course, at the time that we were in the process of constantly improving our information and the data base upon which that judgment had to be made. But that basis was not personal to the members of this subcommittee.

I referred in my earlier questioning to an agreement reached at the White House on this question. I haven't all the documentation that I intend to get on the point before this hearing concludes.

In part 5 of the hearings of this subcommittee in 1970, at page 1596, a number which suggests, I may add, the thoroughness of the hearings at that time, there is contained this letter from the Secretary of HEW to Mr. Thomas C. Mann, president of the Automobile Manufacture Association, dated September 2, 1970.

This letter codifies the policy that had been adopted by the administration prior to the enactment of the 1970 act. I read in part as follows:

> The intention of this department to require a reduction in motor vehicle emissions beyond those proposed for application in 1975 models in the Federal Register issuance of July 5, 1970, is a matter of public record. At the Environmental Quality Council meeting on November 20, 1969, which was attended by representatives of the four major domestic manufacturers, Secretary Finch presented this department's interim and ultimate goals for vehicle emissions.
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> The interim goals were proposed for the 1975 model year; the ultimate goals were proposed for 1980.

May I read this second part from that letter: More specifically, a paper referred to in the letter—

> * * * section to demonstrate that further reductions in such emisisons beyond those we have proposed for 1975 will be necessary, and that he order of magnitude of the needed reductions is consistent with the goals we previously announced for 1980.

There was a press conference at the White House on November 20, 1969,[4] referring to that policy decision, in which Secretary Finch said this:

> We have, as of this point, laid down emission standards to ensure clear air and to protect health for about 90 percent of the urban population. We had discussions today about target dates in 1975 and 1980, with respect to what would have to be done in terms of controlling emissions, in terms of formulating fuel. It was a very satisfactory conversation and discussion.

Mr. Cole, president of the GM, had this to say at that press conference:

> We further feel that the program that has been outlined to us here today by the government can be achieved, providing we obtain enough time. We have the

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[4] The minutes of the White House press conference may be found at p. 439.

technical ability to do the job and handle it properly, but the question is of manufacturing feasibility.

There was no challenge of the health basis of those standards. Those standards. Those standards were the same standards incorporated in the 1970 act. The only difference between the policy announced at that press conference and the 1970 act was the time for accomplishment, not the health basis for the standards.

The industry did not challenge the health basis of the standards.

Why do I emphasize this? I emphasize it because the challenge to that basis is being conducted by at least some portions of the industry today, and has been for some weeks, by such means as this full-page Chrysler Corp. advertisement in the New York Times dated March 13, 1973.

The implication in the advertisement is that we somehow arbitrarily set some health standards unrelated to reality.

Let me read this from the advertisement:

> If you will take the time to read the rest of this page you will see why we believe that—

that is, the consumer will not get his money's worth—

> You will see why we believe that the 1975 and 1976 Federal emissions controls go beyond what is necessary to protect our health; will not result in significantly cleaner air.

These standards so described in the advertisement are the standards down for 1980 and the White House policy set after meeting with the industry, as I indicated after reading from the transcript. Present at that meeting was Mr. Virgil Boyd, president of the Chrysler Corp.

If there is no objection, I would like the advertisement to be put into the record.

[The advertisement referred appears opposite this page.]

Senator MUSKIE. Mr. Ruckelshaus, I would like you and your staff to examine this advertisement, to analyze all alleged statements of fact with respect to the health question in order that we may respond.

May I say that neither this subcommittee, nor the full committee nor the Congress is interested in any way in picking a health standard out of the air and laying it down as an impossible challenge for the American automobile industry. We are not scientists. We are not doctors. We are not the Public Health Service.

We believed in 1970, and we believe today, that we have a right to rely upon the professional advice of the Nation's doctors and the Public Health Service to lay down the standard that we have a right to require of the automobile industry. That is what we have done. That is what we will continue to do.

So far as we are concerned at the present time, although we are aware of the dispute of the fact that there will never be full agreement, especially from the automobile industry, the industry to be regulated, as to what the facts are.

But we also agree from the evidence as we have gone along in pollution legislation that we have never overstated the health effects or the public health and welfare effects of pollutants.

Facts about the 1975-'76 Federal Emissions Standards

Time is running out.

The automobile industry is already freezing designs, buying materials and commiting production facilities for emissions control systems to meet federal standards set for your 1975 and 1976 car. We work that far ahead.

The automobile industry is concerned about air quality, just as you are. We have already done a large part of the job of cleaning up emissions from motor vehicles. And we are totally dedicated to taking the automobile out of the air pollution problem. But we believe the '75 and '76 federal standards are more stringent and more expensive than necessary.

The control systems for meeting them will cost you a whopping increase in the price of your car, starting in 1975. You'll be paying more for gas and maintenance too.

We don't think you are going to get your money's worth.

If you will take the time to read the rest of this page, you will see why we believe that. You will see why we believe that the 1975 and '76 federal emissions controls . . .

- Go beyond what is necessary to protect our health
- Will not result in significantly cleaner air
- Will waste both money and natural resources
- Could (according to the National Academy of Sciences) "engender an episode of considerable national turmoil."

We also believe that there is a positive alternative in the proposed California standards . . . standards which are more than adequate to protect our health and our environment, but at a far more reasonable cost.

WHAT YOU PAY

It could be as much as $1,300 extra to own and drive a car after 1975.

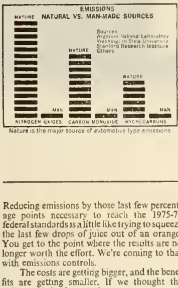
The federal emissions standards for motor vehicles set by the 1970 Clean Air Act call for reducing emissions of hydrocarbons, carbon monoxide and oxides of nitrogen to almost zero. Specifically, by 93% to 97% from uncontrolled levels.

It seemed like a good idea at the time. People were genuinely concerned about air pollution, and it was assumed that motor vehicles were a real threat to health. Congress acted on that assumption. We can't fault them for that.

But we had come a long way *before* the Act was passed, and we have come a long way since, both in cleaning up the exhaust from your car and in learning more about the effect of motor vehicle emissions on air quality.

Four things you should know:

1. Science has learned a great deal more about the sources of hydrocarbons, carbon monoxide and oxides of nitrogen in the atmosphere. The fact is that *nature*, not man, is the major source of these gases. Nature produces six times the hydrocarbons, ten times the carbon monoxide and fifteen times the oxides of nitrogen man produces.



Nature is the major source of automotive type emissions

2. The part played by motor vehicles today in the air quality problem is smaller than most people realize. In terms of harmfulness, scientists say that cars account for only about 10 to 12 per cent of our potentially harmful man-made emissions.
3. No automotive company we know about has found a way to meet both the 1975 and 1976 standards. Even with our breakthrough electronic ignition system, and even with our reputation for "extra care in engineering," Chrysler Corporation engineers have not been able to do it, either.

   Part of the problem is that carbon monoxide and oxides of nitrogen are like the opposite ends of a see-saw. When one goes down, the other goes up. Reducing both (as we must do to meet the 1976 standard) is a problem no one has solved.
4. The only system with any hope of meeting the standards will be very expensive. It could add as much as $1,300 to the cost of buying and driving a car for just the first five years.

Why so expensive?

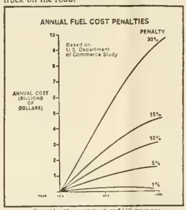
The reason is simple. To get from the control level we have now to the level demanded by the government, we'll need very costly catalytic converter systems on every car. And at this point, these systems are delicate and not fully proven.

There has been a wide range of estimates of the probable cost to you, the car buyer, for the catalytic converter and the hardware for controlling and protecting it. The lowest is about $275.

That's just the beginning.

When you burn out a catalyst, you will have to pay to replace it.

Cars using catalysts may pay a fuel cost penalty of as much as 30%. That could cost the nation as much as $10 billion a year. And that's about $100 a year for every car and truck on the road.



It could cost you as much as $100 more per year in fuel to drive your car.

It all adds up to about $1,300 for the first five years you drive your car. And that's not *our* guess. Here's how we arrived at the figure:

According to a recent report of the scientists appointed by Congress to advise on emissions control:

> **"Average annual costs of a dual-catalyst emissions-control system, including maintenance and fuel, with the increase in sticker price amortized over five years, is estimated to be $260 per year, compared with a 1970 model year vehicle."**
>
> Source: National Academy of Sciences.

($260 times five years equals $1,300.)

Obviously the car owner who keeps his car for less than five years will pay even more per year, since the cost of the original equipment will be amortized over less time.

There's more

Here are a couple of other serious problems you should know about:

- Catalytic converters must utilize expensive and exotic metals like platinum and palladium. (The National Academy of Sciences says it would take up to 3 million ounces a year. That's equal to the entire world supply in 1970.) We don't have these metals in the United States.

  They would have to be imported from Russia and South Africa, making a major U.S. industry dependent on these countries for its operation.
- The petroleum industry would have to spend about $5 billion for new refineries and distribution systems for the unleaded gas required by cars equipped with catalysts.

  Oil imports, because of catalyst-equipped cars, could total $42 billion for the ten years from 1975 to 1985. (That amount would pay for nearly all the U.S. annual expenditure for health and medical care!)

WHAT YOU GET

Very little more than you already have.

Reducing emissions by those last few percentage points necessary to reach the 1975-76 federal standards is a little like trying to squeeze the last few drops of juice out of an orange. You get to the point where the results are no longer worth the effort. We're coming to that with emissions controls.

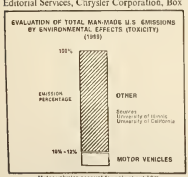
The costs are getting bigger, and the benefits are getting smaller. If we thought the stringent federal controls were necessary to protect the public health, we would spare no effort or expense to meet them. But the evidence shows they are *not* necessary, and we see no reason to waste the public's money going *beyond* what is necessary.

What about health?

The fact is, with the reductions already achieved, there is no scientific evidence showing a threat to health from automotive emissions in the normal, average air you breathe. Not even in crowded cities.

And the automobile industry has already done more than any other segment of American society to clean up the air.

New scientific studies indicate that the automotive threat to health has been misunderstood and exaggerated. (If you'd like to check them out yourself, write to Research and Editorial Services, Chrysler Corporation, Box 1919, Detroit, Michigan 48231. We'll send you the information.)



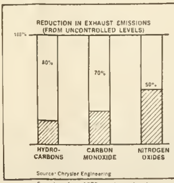
Motor vehicles account for only about 10% to 12% of harmful man made emissions.

Here are some of the things these studies show:

- It's true that by weight, auto emissions may account for 40% or more of man-made emissions. (And remember that's a relatively small part of *all* emissions.) But when you measure them by their harmfulness to the environment instead of by weight, they account for only about 10% to 12%.

> **Some interesting comparisons:**
> - *Heating your home for eight hours with an oil furnace would use up your car's 1976 daily quota of oxides of nitrogen.*
> - *Burning one log in your fireplace would produce as much carbon monoxide as the 1975-'76 standard allows your car daily.*
> - *The vegetation in your back yard gives off as many hydrocarbons as the 1975-'76 law permits your car.*

- A study of the effects of carbon monoxide on 30,000 people living in crowded cities shows that the level of CO in the blood of nonsmokers is well below the level at which anyone has observed any effect.

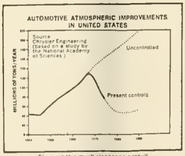


Emissions from 1973 cars have already been sharply reduced

Most of the job has been done

The automobile industry has not been asleep. We were working hard to reduce harmful emissions from cars some 20 years before the Clean Air Act. And we've made a lot of progress.

Your 1973 car emits 80% fewer hydrocarbons...70% less carbon monoxide...50% less oxides of nitrogen than a car without controls. *Result, the air in our cities is getting cleaner every year.*



The air is this much cleaner as a result of present emissions controls.

And it will continue to improve, as older, uncontrolled cars come off the road.

Despite this pretty impressive track record, the 1975 federal standards call for reductions of 90% in hydrocarbon and carbon monoxide emissions. NOT from uncontrolled cars, but from the already improved 1970 cars. And how about nitrogen oxides? Here the 1976 standards demand 90% reductions in emissions of oxides of nitrogen from the levels of uncontrolled vehicles.

The effect on your car

A serious side effect of the emissions controls required in attempting to meet the 1976 standards is that your car won't run as well. For instance, acceleration capability would be reduced. And in the words of the National Academy of Sciences,

"There is also concern that poor performance of such cars will make them unsafe in certain circumstances, for example, if the vehicle stalls when accelerating into fast moving traffic."

Why not the California standards?

We're all for emissions controls . . . but only to the extent that scientists agree is necessary to protect public health and improve air quality!

The State of California (which has the most serious automotive air quality problem) has proposed standards which are tougher than current federal standards, but more realistic than those called for by the Clean Air Act for 1975 and '76. California believes that they are adequate to protect the public health. And so do we. For *all* America.

And . . . given an additional year of development time . . . we believe we can meet those tough California standards without expensive catalysts! Without the big fuel-cost penalty. Without an adverse effect on our international balance of payments. And at a cost about 1/3 that of the federal standards.

That means that you, as a car-buyer, can have the cleaner air we all want . . . a healthy environment . . . and a more efficient, better performing car . . . and at a reasonable price.

> **If you agree, we urge that you write your Senators and your Congressman. Tell them you want clean air . . . but that you expect a dollar's worth of benefit for the dollar you spend to get it.**
>
> **Let's have clean air . . . but let's not throw money away!**

CHRYSLER CORPORATION

Extra Care In Engineering . . . It Makes A Difference.

We found it to be true that as our information is enlarged, as it becomes more refined, our estimates of damage have been underestimated rather than overestimated in the past.

That doesn't lead us to conclude that overestimation may not at some time be the result of any basis that we lay down. But that has not been our experience.

I am really using this for the purpose of making this point because I think it is critical to the challenge the industry has laid down to the Congress.

Industry has made no secret of its intention to try to change this law. In response to that I say to them and to the American people, we are not interested in laying down an arbitrary standard nor will we, but we will rely, as we think we have a right to rely, upon the advice of that scientific community which is paid to serve the Government of the United States, the people of the United States, and the Congress of the United States on this subject.

We will not be panicked by such advertisements as that to which I have referred and which I put in the record. I think it is important to say that. As we go along we will welcome testimony from whatever source available, including the health experts you will make available to us in the next day or two, to examine this issue because it is critical.

If we lay down a wrong basis in what we impose on the American people, there will be heavy costs and we may raise unnecessary alarms. If the standard we lay down is inadequate future generations of Ameriicans will suffer from the point of view of health for our failure.

We recognize the importance of this issue on both sides, as I know you do. It is our intention to fully examine it as this year goes on.

That isn't a question, strictly, but if you would like to respond in any way.

After you have responded and after Senator Randolph puts a question that he would like to, we will yield to Mr. Buckley and I will wait for my turn again.

Mr. Ruckelshaus. I certainly agree with your emphasis on the importance of being willing to review these standards at any time if it appears there is any question. Also, as I stated earlier. I agree that as we get more health effects data what we tend to find is health effects at lower levels of these pollutants.

We have prepared a fact sheet on the advertisement which you referred to and sent out, I am informed, in the neighborhood of 1,000 responses to inquiries about this advertisement, many of them to Members of Congress who have referred to us inquiries from their constituents about this advertisement. We think there are some serious problems with it and we try to point those out in that fact sheet.

I will be glad to submit that as a part of the record.

Senator Muskie. The understatement of that comment, I think, is testimony as to the solidity of your approach to the problem.

[The fact sheet referred to follows:]

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON D.C.

The Federal Automobile Emission Standards
Their Purpose, Their Need, Their Impact

Recently the Federal automotive emissions standards have come under criticism from some quarters of the automotive and petroleum industries. This paper attempts to present relevant facts on the issues raised.

I. Emissions of Air Pollutants from Automobiles

In U. S. cities the automobile is a major contributor to the man-made emissions of carbon monoxide, hydrocarbons, and oxides of nitrogen. It is estimated that in cities motor vehicles will be responsible for the emission of 50% to 90% of these pollutants in 1973.

Industry Statement--Drastic reductions have been made in automotive emissions due to the Federal standards; a continuation of present control measures is sufficient.

EPA Position--It is true that, as a result of the promulgation of emission control standards, substantial progress has been made in reducing emissions from new vehicles. However, even greater control is required if we are to clean up the air in our major cities to a degree which protects against the known adverse effects of air pollution on our health and property.

National air quality standards for automotive pollutants were set to protect the public from the adverse health effects of these pollutants. However, in order to achieve these standards over 26 major metropolitan areas will require additional controls or motor vehicles above and beyond those imposed on new automobiles. These transportation controls (which may include restriction of parking, vehicle inspection, mandatory maintenance, gas rationing, and conversion of vehicles to gaseous fuels) will be designed to control automobile air pollution. All the help these cities can get through the achievement of the Federal new car emissions standards must be provided.

Industry Statement--Natural processes emit quantities of air pollution much larger than those emitted by the automobile. Natural processes also remove automotive pollutants from the air.

EPA Position--It is misleading to base an argument against the control of emissions on estimates of worldwide emissions of pollutants produced by vegetation and other natural sources.

Natural emissions occur in a widely diffuse fashion, and are distributed over the entire world. Man, on the other hand, concentrates his activities on a very small portion of the earth's surface. With 75% of all Americans living on only 1.5% of our total land area, the emissions of automobile pollutants are similarly concentrated. This results in adverse levels of pollutants building up in all the major urban areas. Natural removal processes do exist for all the major air pollutants but these processes are quite slow, and come nowhere near to solving the problem of pollution accumulation in urban areas.

Industry Statement--Emissions from sources around the home (burning fireplace logs, fuel oil furnaces, and the mere existence of backyard vegetation) can be comparable to those resulting from using an auto meeting the 1976 Federal emission standards. Any one of these sources will use up a person's "emission quota" for that day.

EPA Position--The 90% reduction in automotive pollutants that was mandated by Congress in the Clean Air Act was designed specifically to remove the automobile from its role as the dominant source of air pollution in our urban areas. Comparing the emissions of a 1976 automobile to those of relatively less important sources of pollution simply points to the success of the Clean Air Act in achieving its goal.

In direct reference to the comparisons made between 1976 automobiles and burning logs, it should be pointed out that such a comparison can only have real significance if we assume that the fireplaces are used daily throughout the year, in every household that owns a vehicle, and that these households can be as concentrated in downtown areas during peak traffic periods as are automobiles.

Comparisons of natural HC emissions from a backyard and a 1976 automobile evoke the same comments as above. However, it should be pointed out that the research in this area must be considered to be preliminary and that the emissions data available can be used to support a wide range of estimates on HC emissions data per square foot of vegetation. One interpretation of these data is that the 1976 automobile will emit only as much hydrocarbons as a vegetated five acre plot. Clearly, in major urban areas, five acre plots of vegetated earth are far outnumbered by our automobiles.

Industry's Statement--California, with the oldest and most severe auto-related air pollution problems in the nation, does not support the Federal new car standards for 1975 and 1976 and, in fact, has established its own standards for 1975 which are much less stringent than those required by the Federal government.

EPA Position--The standards proposed by California for 1975 were formulated back in 1969 and were based on estimates by their engineers of available emission control technology. The California standards do not take into account the rapid advances in emission control technology since 1969 and were never meant to provide the reductions needed to meet air quality standards within the timeframe specified by the Clean Air Act. In fact, even meeting the 1975-76 Federal emission standards will not achieve the air quality standards in parts of California without a major curtailment of vehicle use. It is easy to agree with the industry that meeting the much less stringent proposed California standards would be easier and cheaper for the auto industry. The point, however, is that this would not meet the needs of the nation's cities for controlling automobile-caused air pollution.

II. Health Effects of Automotive Pollutants

Automobile emissions of hydrocarbons and nitrogen oxides react in the atmosphere in the presence of sunlight to form toxic photochemical oxidants. These oxidants have detrimental effects on persons with respiratory illnesses, cause eye irritation and watering, and have destructive effects on rubber products and synthetic fabrics. Nitrogen dioxide, one of the nitrogen oxides, can as well cause adverse respiratory effects.

The carbon monoxide emitted by automobiles is absorbed through the lungs and thereby reduces the oxygen carrying capacity of the blood. The carbon monoxide in the blood takes the form of carboxyhemoglobin (COHb). At levels of COHb just over 2% our visual and time interval discrimination can be impaired. Increased COHb levels have also been shown to have adverse effects on heart patients.

The national air quality standards are designed to protect against these harmful effects.

Industry Statement -- The carbon monoxide emissions from automobiles are much less toxic than stationary source related pollutants; in particular sulfur oxides. For this reason we should turn our interests more towards these other pollutants.

EPA Position -- This is not a relevant argument. The goal of the Federal air pollution control program is to eliminate all air pollution problems; not eliminate some and leave others. The Clean Air Act requires control of sulfur oxides to whatever level is necessary, as well as control of carbon monoxide.

The Federal Automobile Emission Standards--Their Purpose, Their Need, Their Impact (cont'd)

Industry Statement--Average carbon monoxide blood levels of people in major urban areas are below those levels related to effects on health.

EPA Position--Examination of "average" concentrations of carbon monoxide in the blood of urban dwellers is a dangerous approach to determining the hazard to the population. This type of data gives no indication of how many people have levels which exceed the acceptable health levels. It is known that some people receive a greater exposure to high pollutant levels than others and that some are more strongly affected by a given level of pollutant concentrations. The Clean Air Act mandates the EPA's standards protect the health of not only the "average" man but also those subgroups more exposed or more vulnerable than the average man.

Industry Statement --Carbon monoxide blood levels of smokers are higher than those for non-smokers.

EPA Position--The carbon monoxide blood levels in smokers have little relevance to the stringency of automotive emission standards. Smokers smoke by choice and know that it is harmful to their health. Non-smokers, on the other hand, have the right to be adequately protected against CO even if smokers elect to pursue their habit.

Industry Statement--"Average" street level concentrations of automotive emissions are low enough that they pose no threat to human health.

EPA Position--EPA's air quality standards are based on known adverse health effects. Air quality measurements show that these standards are being exceeded in many of our urban areas. The use of a concept such as "average" concentrations is misleading because it ignores the adverse effects on specific individuals of exposures to pollutants for specific times in specific places.

III. Pollution Control and Fuel Consumption--

The automobile is a major source of air pollution in the United States. This is easier to understand when we realize that we Americans drive our cars nearly 1 trillion miles a year and in the process consume nearly 70 billion gallons of gasoline. This is the equivalent of 14% of all the energy resources consumed in the United States annually. The pollution abatement efforts of the automotive industry have increased the fuel consumption of our automobiles but not by as much as some would have us believe.

Industry Statement--The 1975-76 emissions standards have an adverse effect on automotive fuel economy and may increase fuel consumption by as much as 30%

EPA Position--A recent study on automotive fuel consumption conducted by EPA shows that emissions controls do have an impact on fuel economy. This study estimates that the loss in fuel economy for 1973 model year vehicles over those with no emissions controls is in the range of 7% to 8%. Data available from a major domestic manufacturer indicates that the fuel economy of 1975 vehicles with their additional controls should remain unchanged from 1973. A fuel economy loss of this magnitude would increase the average drivers fuel bill by less than $25 a year. EPA estimates the increased fuel consumption for 1976 model cars to be in the range of 10% to 12%, again far below the 30% seen in many industry statements.

To put the fuel penalty of emissions controls into proper perspective, EPA has also quantified the fuel penalty associated with consumer choices such as automotive air conditioning, automatic transmissions and increased vehicle weight. That analysis shows an average fuel economy loss of 9% for air conditioners (installed on over 60% of new vehicles), and of 5% to 6% for automatic transmissions (installed on over 90% of new vehicles). Differences in vehicle weight can account for as much as a 50% loss in fuel economy.

Industry Statement--Catalyst equipped cars will suffer fuel economy penalties.

EPA Position--The use of a catalytic convertor as an integral part of emissions control systems does not of itself create a significant fuel economy loss. These convertors, which are attached to the exhaust system much like an acoustical muffler, by themselves create no more fuel economy loss than does today's standard exhaust muffler.

IV. Cost of Emissions Control

The cost of owning and driving an automobile includes the initial price, maintenance costs and operating costs. The Department of Transportation has estimated the total cost to be approximately 11.9 cents per mile or $11,900 over the 100,000 mile life of a vehicle. Emission controls will add to the cost of owning a vehicle. The increased operating cost due to a reduction in fuel economy was estimated above. The increased initial cost of

The Federal Automobile Emission Standards--Their Purpose, Their Need, Their Impact (cont'd)

a 1975 model year vehicle due to emissions controls should lie in the range of $150 to $300 which is only 2 to 3 percent of the total. The additional equipment needed for 1976 to control oxides of nitrogen could raise the upper limit of our cost estimate to approximately $350.

Industry Statement -- Government studies say that 1975-76 standards could raise the price of a new car by $500.

EPA Position -- Using acknowledged and informally obtained automotive industry data as a base, an Office of Science and Technology report published in 1972 did use a $500 initial cost figure. However, cost data later obtained by EPA from industry sources at formal public proceedings, and more recently obtained in preparation for new proceedings indicates that cost will be lowered substantially below this level.

Industry Statement -- Emissions control systems will require the use of expensive and rare metals from outside the U.S.

EPA Position -- Most American manufacturers intend to use precious metal catalysts as an integral part of the emissions control systems. Adequate supplies of the precious metals used in these systems can be imported at a cost of from $5 to $15 per car, depending on the configuration of the catalyst used. It should also be noted that several emissions control systems tested by EPA have met the 1975 standards without precious metal catalysts. Neither the Clean Air Act nor EPA prescribe that specific technologies be adopted. The Government sets the emissions standards; industry chooses the technology.

Industry Statement -- Precious metal catalysts require the use of lead-free fuels which cost more than the leaded grades.

EPA Position -- Catalytic systems are effectively deactivated by the anti-knock compounds of leaded gasoline. The lead-free gasoline required for catalysts does cost more at the pump but a study conducted by EPA on the effects of lead additives shows that this cost will be offset by the increased life of spark plugs and mufflers resulting from the use of lead-free fuels.

Industry Statement -- The costs of automotive pollution control exceed the benefits.

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EPA Position -- Reliable estimates of the benefits applicable to health and property have not been developed because of a lack of consistent data. This does not imply that there are no health and property benefits from reducing automotive pollutants. It simply means that these benefits have yet to be quantified, and translated into dollars. The benefits cited by some sources include only those which have been estimated for materials and vegetation. In ignoring the benefits to health and property any comparison of automotive pollution control costs and benefits is incomplete and misleading.

March 1, 1973
Office of Air and Water Programs

Senator MUSKIE. Senator Randolph.

Senator RANDOLPH. Thank you, Mr. Chairman.

I think you made a good speech.

On February 10, 1973, the U.S. Court of Appeals rendered its decision,[5] and you have commented by stating that "weighing the social disruptions that might result from denial of suspension against the environmental costs if granted suspension, the court concluded that the adverse effects on the public that could result from an erroneous denial of suspension were potentially more serious than the adverse effects on air quality that would result from granting suspension, even if no interim standards for 1975 were prescribed."

I wonder, Mr. Ruckelshaus, whether you have sufficient authority to do this balancing act. What do you think? Can you do it without further direction from the court?

Mr. RUCKELSHAUS. If we don't have any further direction, we are done. But based on some of the statements made right after the decision there is likely to be some court challenge.

To my knowledge, we have as yet received none. I think it is too early to tell. It certainly is possible that in what we have attempted to do here, acting as I felt the court mandated me to act in the public interest, in a broad sense of defining the term "public interest" under the statute, it may be that a court could determine that what we have done is unauthorized under the law.

It is not the simplest question in the world to decide. If that were true and if Congress agreed with the approach we have taken it may be necessary for some congressional attention, additional attention, because of a subsequent court decision.

We attached to the decision a chart which indicated what the impact was because of the 1 year extension of time. You can see the line in between, the reductions that would be achieved if we stuck to the 1975 standards and what the extension would give. It is this space in here that is very minimal that we are talking about.

If you stick to the 1973–74 standards you start going up again very quickly. Under this procedure we go down to 1990 when it starts to go up again because of the increased number of cars. This chart happens to be for hydrocarbons. There is a similar chart for carbon monoxide. That was the chart that we used in this weighing process.

Senator RANDOLPH. You can't grant another 1-year extension, that is correct, isn't it?

Mr. RUCKELSHAUS. Yes, that is right.

Senator RANDOLPH. I believe, Mr. Chairman; it would be helpful if we could receive from EPA the information and the data that we will need, frankly, to work in this balancing operation with respect to the possibility of another extension by the Congress, but, more importantly, with respect to nitrogen oxide standards in the Clean Air Act, which, as I understood you, Mr. Chairman, will be the main thrust of the hearing tomorrow.

Senator MUSKIE. Yes.

Senator RANDOLPH. Would you have any comments at all?

Mr. RUCKELSHAUS. We will be happy to give you any data we have. In the technical appendix to the decision there is a good deal of data

[5] Reproduced at p. 348, appendix.

relating to these figures. Clearly, if the automobile companies want additional time under the amendments, I have no more authority to grant it.

The question of any additional time will be before the Congress. At that point I assume we will have to provide whatever data we have and we will certainly be willing to do so, on which the Congress would make some sort of judgment.

Senator RANDOLPH. Do you think next month will quiet this subject matter you are discussing today, from your standpoint, or will it continue to be discussed even with more vigor than it is as you appear today?

Mr. RUCKELHAUS. Senator, I have tried to give some thought to this in the past. In my opinion, in the next decade it may quiet down but not the next month. I think we are going to, as a nation, achieve emission restrictions and levels of air pollution that fully protect the public health and the environment. I think a lot of this reduction is because of acts like the Clean Air Act have passed. I have said that many times and I really believe that. But in the decade involved in achieving this there is going to be a lot of controversy and a lot of wrenching and a lot of public discussion about this problem.

I don't see any way out of it. I frankly don't think you can make any progress without it and you can almost gage the amount of progress you are making by the intensity of the controversy.

Senator RANDOLPH. I agree that the intensity will increase, frankly. You haven't said that but you implied it.

Mr. RUCKELSHAUS. Yes.

Senator RANDOLPH. I think that will happen. Sometimes even the differences could be the strengths as we find ways to move together rather than in opposite directions.

Mr. Chairman, I expressed great confidence, as you will recall, when we had Mr. Ruckelshaus before us at the time we reported his nomination to the Senate and his subsequent confirmation which became effective.

I think, Mr. Administrator, you have had perhaps one of the most difficult assignments that could be given to anyone, because of what you are doing and its effects on the whole economy of this country.

This weighs heavily upon you, I have no doubt. I only want to say that I had confidence in you then, and I have confidence in you now. I know that you will just take the facts as you read them and move forward.

Thank you.

Mr. RUCKELSHAUS. Thank you, Senator.

Senator MUSKIE. Senator Domenici.

Senator DOMENICI. Thank you, Mr. Chairman.

I have a couple of questions, Mr. Ruckelshaus, that relate to your proceedings to enforce the standard in California and not elsewhere as it relates to interpretation of the statute, wherein you get the authority, or feel that you do.

I happen to think the decision is a correct one, as I listen to you and as I read related documentation. Would you tell us the extent to which you are confident that the law permits you to pick out one State and impose strict regulations on it for 1 year and not elsewhere.

If there is some doubt as to the legality of it, I would like for you to tell us about that doubt, if you can.

Mr. RUCKELSHAUS. I think it is fair to say I am more confident when I read the court decision than I am when I talk to our own lawyers. However, the appeal, not only legally but otherwise, of using the State of California as the mechanism for phasing the catalyst in, is the fact that it was recognized in the law itself.

No. 1, California had a peculiar air pollution problem that made it necessary to address in a special way. California is also recognized as being the State that had done the most about attempting to control air pollution on their own without any help from the Federal Government.

The statue provided preemption of automotive emission standards by the Federal Government nationwide in every State except California. California was given the right to request a waiver of the application of Federal standards if they wanted to address their problem in a special way. There is some confusion as to precisely what kind of waiver California could be given. Could they, for instance, ask for a stricter standard in one pollutant and a more relaxed standard in another one to attempt to address their problem?

It is not clear under the statute, just what they are permitted to do. But they have requested and received in the past from us a waiver for the achievement of various standards. At present they have been granted a waiver for 1974, particularly, in the achievement of an NOX standard of 2 where the Federal standard is 3.1.

They requested for 1975 a waiver that we can have in part in this decision granted. Clearly we have the authority to do that under the statute.

The request was based on the 1975 test procedure in hydrocarbons to have emission of 0.9 gram which we granted; for carbon monoxide, 17. We proposed a standard of 9 for carbon monoxide because we felt it was necessary. It wasn't the granting of a waiver but the setting of a Federal standard.

That, under some interpretation of the act, might be attacked, legally.

Again I think given the history of the act and what Congress has done, we have the authority to do this. We reduced it down to 9 in carbon monoxide because we felt that level was necessary to force catalysts to be tried as the automobile companies, two of them, said they were willing to do in California.

In the case of nitrogen oxides, in 1975 they requested a 1.5 level. We had already granted a level of 2 for 1974 and we felt because of the question we have about nitrogen oxide statutory standards, on the other hand, the need that California has demonstrated for a lower nitrogen oxide standard, to remain at the 1974 level was probably the best course to take.

So we did not, in effect, grant the requested waiver for 1975 but sustained it at the 1974 level.

I would be the last to claim that there is no legal challenge that could be made to this decision, as there can be to most any decision. But I think we are on defensible grounds, and based on the broad definition of public interest that the court provided us with, and the history of the act that I have in part recited, we would be sustained.

Senator DOMENICI. Our chairman has discussed the health qualities of the standards, health capabilities of the standards, at some length.

You have said that California as a State was out front in terms of standards in comparison with the rest of the country. It is my understanding that California has different standards. Had we not a Federal law that preempted, that went into effect, they would have a different set of standards than we established, is that correct?

Mr. RUCKELSHAUS. Yes. California established a different set of standards, as cited in some of the advertisements cited earlier, in 1969. These standards were based on what they felt was technologically achievable within a given time frame and were not directly related to the necessity of protecting the public health.

Senator DOMENICI. So it is your testimony that the California standards are not the best health standards at this time?

Mr. RUCKELSHAUS. I don't think California claims that the purpose of these standards was to achieve the levels of air quality necessary to protect the public health. They were based more on technological considerations.

Mr. Stork is more familiar with this than I. I guess that is essentially what he would say.

Senator DOMENICI. One further question about some of your statements heretofore on the percentages of cars on the market, the new ones, next year that will be affected by the decision. You have estimated approximately 10 percent of the cars produced in 1975 will have the catalyst or alternatively manufacturers may very well decide to drop certain lines of cars in that year.

Does this relate to the 10 percent share of the market which California represents or is this in addition to the California experience?

What percentage of cars nationally are you referring to?

Mr. RUCKELSHAUS. You can see where that 10 percent figure might be confusing. We think that all the automobiles produced by the domestic manufacturers that will be sold in California that meet the standards will have to use catalysts.

There could be some that could achieve these standards without catalysts. If they can, all to the good. The more different kinds of technology we can advance, the better. Some of the foreign automobiles will be able to meet these standards without the use of a catalyst. The interim nationwide standards that we set of 1.5 and 15 for HC and CO regretfully, we think, based on the best analysis we could make, can be achieved by most all domestic manufacturers without using catalysts.

However, we think that for some model lines it may be necessary for them to use catalysts nationwide by 1975.

What will probably happen is they will run certification runs to certify the automobiles with one engine using a catalyst and one without. If the one without the catalyst does not achieve the certification numbers, and the one with the catalyst does, they then can elect to distribute and attempt to sell the catalyst equipped automobile nationwide or to drop that car line from nationwide sale.

Again, it is entirely possible that the one with the catalyst will run better than the one with the advanced engine modifications necessary to achieve the certification numbers.

Our best estimate is that in the neighborhood of 10 percent of the nationwide cars may be using catalysts in 1975.

Senator DOMENICI. Thank you, Mr. Chairman.

Senator MUSKIE. Senator Buckley.

Senator BUCKLEY. Mr. Ruckelshaus, I would like to ask you first of all to clarify my own understanding on the question of the fuel economy or lack thereof in the catalyst system. You testified earlier today to the effect that your studies do not show that bringing the catalytic system on stream, as it were, will materially affect fuel economy.

Is this or is this not inconsistent with a conclusion in this National Academy of Sciences report [6] to the effect that, "the dual catalyst system is expected to have poor fuel economy."

Mr. RUCKELSHAUS. Yes; the dual catalysts system is not the system that will be used to achieve the 1975 standards. The dual systems will be necessary to achieve the 1975 and 1976 nitrogen oxide standards. We do not dispute that there is a fuel penalty associated with the use of the dual catalyst system. But that is not what we are talking about in this decision.

Senator BUCKLEY. In analyzing the decision, we have to think through to 1976, don't we?

Mr. RUCKELSHAUS. I think that is correct. That is why we believe it is necessary for the Congress to address the nitrogen oxide problem with a certain amount of expedition. Not only do we have to do it, but it's necessary for the technological and planning assessments of the automotive industry to know what that 1976 standard is going to be.

Senator BUCKLEY. During my first session of asking questions I asked you as to whether or not the oil industry would be in a position to develop lead-free gasoline in time for use in California. There is another factor in the movement toward the catalytic system, namely the need to have monitoring equipment broadly distributed which will enable somebody to determine whether or not the user is in fact utilizing his car in accordance with instructions and whether or not his emission system is continuing in good working order.

Do you have any light to give us as to whether or not we can anticipate in California adequate monitoring equipment?

Mr. RUCKELSHAUS. Yes. We think that is another reason why the phase in using California made sense to us, that we believed California, because of a testing procedure they already have, will be able to adjust to the testing of a catalyst in 1975 to insure that it is being properly used and maintained, and this information that is gained from their experience can, in a more orderly fashion, be transferred nationwide a year later.

Again, it is because of the advance that California has had over the rest of the Nation in dealing with this problem that makes that geographical area particularly attractive to use as a phase-in of new technology. It has been done before. They phased in new technology in California in the past before it was used nationwide.

Senator BUCKLEY. Has that earlier technology required systematic checkups on individual automobiles to find out if they are operating within the earlier restraints?

Mr. RUCKELSHAUS. Mr. Stork is more familiar with the California procedures than I am.

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[6] The report may be found at p. 193, appendix.

Mr. STORK. Senator Buckley, it is a difference between the need for technology to inspect in-use cars and the availability of that technology.

We published late last year the results of work that had been done over a couple of 3 years that showed the kind of reductions that might be possible from inspecting in-use vehicles. Those numbers range from 6 to 15 percent reductions in HC and 12 to 15 percent reductions in CO in today's cars.

The problem in making this technology available is twofold. One, this data is based on work done under essentially laboratory conditions and it is now necessary, and we expect to do it later this year, to get some pilot programs going to see what the technicians could make work under laboratory conditions can really work in actual use.

Still, Senator, we are dealing with today's kind of cars. It will be necessary to do extensive laboratory-type in-use vehicle inspection and later pilot programs to see what the results can be from catalyst-equipped cars.

You really can't set numbers until you have that data. Clearly, there are no catalyst-equipped cars running around today. Yet, on a projected basis, it appears quite reasonable to say that the likelihood of being able to make significant reductions in emissions from in-use cars is probably greater for catalyst-equipped cars because they are more sensitive to maladjustment failure than today's cars are.

Senator BUCKLEY. I wasn't speaking so much as to the likelihood that there would be a net decrease. My understanding is that there will be some breakdowns. Whether they will be large or small in number is an argument. But are we able to determine whether or not a catalytic system in a particular car in use is broken down? This suggests the need for readily available testing apparatus, so you can take your car to some place and find out if it is working or not.

Will such equipment be available in time to police the reliability of the catalyst?

Mr. RUCKELSHAUS. The equipment, Senator, is available. It isn't a question of equipment. It is not possible to make any kind of a meaningful statement about emissions from a car except in terms of a test procedure. You can't just count the hydrocarbons as they come out. A test procedure consists of really a couple of things. One, instruments, which is what you are referring to, that measure chemicals or analogs of these chemicals, and, secondly, and far more difficult, a way of exercising the engine while you measure the chemicals. The test procedure used for certification is long winded, complex, and expensive. I won't describe it in detail. It is far too cumbersome to be used for in-use testing. The need, therefore, is to identify a short test that will achieve acceptable correlation with a full Federal tests procedure. While progress has been made in this area, the results have not yet been entirely satisfactory. As far as catalyst-equipped cars are concerned, clearly we have to start testing catalyst-equipped cars to see what kind of correlations we can achieve. We can't get our hands on catalyst-equipped cars as yet.

Senator BUCKLEY. Thank you. Mr. Ruckelshaus. I would like to turn now to the transportation controls feature of your decision. You state in your testimony that the additional control required to offset the effects of the suspension generally will be small. What do you mean by "generally" and what do you mean by "small?"

Mr. RUCKELSHAUS. By "small," I mean in the neighborhood of 2 or 3 percent, which is really within the area of our numbers if we impose transportation controls. By generally, I meant most of the country. I assume you mean how about New York?

Senator BUCKLEY. Yes.

Mr. RUCKELSHAUS. Because the mayor, Mayor Lindsey, and members of his staff testified at the hearings of the enormous impact on carbon monoxide in midtown Manhattan if we granted the request for an extension of time, we did an analysis of New York based on the submission of their numbers as to what this analysis was and provided a chart when the decision was announced showing what that impact was. This, again, is based on the New York City numbers which we have as yet not verified.

[The chart referred to follows:]

PREDICTED REDUCTION OF POLLUTANT LEVELS IN NEW YORK CITY,[1] FROM 1970 TO 1975

[Percent]

	With clean air act standards	With E.P.A. interim standards
Carbon monoxide (midtown)	[2] 52	40
Carbon monoxide (downtown)	33	28
Hydrocarbons (citywide)	31	31

[1] Based on very rapid vehicle turnover and New York City's own calculations.
[2] Figures represent reductions achieved before the implementation of transportation controls.

Source: Environmental Protection Agency.

The reductions in carbon monoxide in midtown Manhattan, as this chart indicates, that would be necessary in order to achieve the Clean Air Act ambient standards have been in the neighborhood of 40 percent. What we have is an additional 12 percent reduction of carbon monoxide needed in midtown Manhattan because of the extension. Again, these numbers have to be looked at as gross numbers. That is primarily because of the turnover in taxicabs in midtown Manhattan and the additional new cars that will be available.

We are going to review the New York State plan, which will include the New York City transportation plan, to achieve these standards by 1975 and to see what kinds of things we might be able to do in order to reduce that number. We think it may be possible, and again this is something we may have to ask Congress about, to cause fleet vehicles to use catalysts, such as taxicabs, in 1975 and thereby greatly reduce this carbon monoxide figure for New York City.

In the hydrocarbon area, since hydrocarbon standards are set because of the need to control photochemical oxidants, we measure those over the entire air quality control region, and the oxidant level is a small problem. As this chart shows, we don't see where there will be any measurable impact of the extension on the hydrocarbon concentration. It is only in those areas of the city where there is a rapid vehicle turnover that you find any significant vehicle impact.

Senator BUCKLEY. How many other areas of the country might find themselves in the position of New York City?

Mr. RUCKELSHAUS. Practically none.

Although, Washington, D.C., which has a rapid vehicle turnover, we believe might have some significant impact, but not as great as New York City.

Mr. SANSOM. I think our nationwide calculation is that the interim standards will make about a 3 percent difference in the reductions. We are asking, as the Administrator pointed out, the States to review their plans but not to hold up the submission today of those plans.

In California it will be less than 2 percent, because we have gone two-thirds of the way to the 1975 standards in California. I don't think there is anyplace in the country that has quite the situation that New York City has.

Senator BUCKLEY. I guess my time is up, Mr. Chairman.

Senator MUSKIE. First of all I would like to return to your comment earlier which I think is reflected throughout the 40-odd pages of your decision, that the only option really available to you in terms of the 1975–76 standards was the catalyst. That was your basic assumption?

Mr. RUCKELSHAUS. Yes.

Senator MUSKIE. First of all I would like to get into the record at this point, and I know other Senators touched upon it already, the degree of your confidence in the catalytic converter as a solution to this problem.

You had this to say about it:

> Overall, catalysts are highly effective pollution control devices. Even a mediocre catalyst can be expected to destroy 80 percent of the carbon monoxide and about 50 percent of the hydrocarbons that pass through it.

Then, under a discussion of the warranty and recall provisions of the law, you say this:

> I believe that catalytic converters will reduce automobile emissions in actual use and may well constitute a more efficient means of controlling pollution from conventional automobiles then engine modification, even when the catalyst operates at a fraction of its potential.

I take those comments to reflect sufficient confidence in the catalytic converter in its present state of development to justify your decision to require them for California in 1975, and also with respect to requiring them nationwide in 1976?

Mr. RUCKELSHAUS. Yes, Mr. Chairman, that is correct. I concluded at the end of the hearings that while there was obviously some dispute as to the effectiveness of the catalyst, that the overwhelming evidence was that it was an effective way of controlling these pollutants, that it was developed to the extent that it could be applied nationwide were it not for the production problems, pointed out by most every witness.

In the time frame in which we are discussing it, it was really the only chance we have of getting significant reductions in air pollution over this 1973–74 level that these charts indicate.

Our estimate is that in order for the domestic industry to phase in new technology, whether it is the Honda system or diesel or any of the other potentials, we are talking about a 5- to 10-year period across all car lines. If we did not give this very promising bit of technology a fair test—and by that I don't mean to imply that we are not convinced now that it locks acceptability—we are not going to get these levels in any other way. I think the technology certainly is effective and available in the sense that the act provided, and, again, to reduce air pollution we ought to encourage its widespread use.

Senator MUSKIE. That decision is not a decision, as I take it, that in the long-term the catalytic converter is a better answer in the automobile emissions problem than, say, alternate engine systems might be?

Mr. RUCKELSHAUS. No, it is not. In fact, to the contrary, I think what this decision does is encourage as widespread development of different technologies and newer technologies or adaptations of old technologies as possible so that we will get that answer. It will be easy, maybe, 2 or 3 years from now for somebody to sit here and say, "That is the answer" when technology itself is clearly evident what the answer is.

Senator MUSKIE. I know you are aware of the concern which I suspect you and your colleagues share, that one effect of this decision may be to push the industry into the direction of catalystic converters when in the long run an alternate engine system or some other technology may be a better answer, not only in terms of quality of the air but in terms of giving the consumer an efficient, drivable automobile. That is one of our concerns. I think you share that?

Mr. RUCKELSHAUS. Yes, I do, and I think it is a legitimate concern, Mr. Chairman.

Senator MUSKIE. Since 1970, there has been a great deal of discussion that by setting a 1975 standard, we may, in effect, have helped to close off those other options. As a matter of fact, I think that is one of the arguments made by some of the automobile industry.

In your discussions with the industry did you find any evidence to indicate that if the deadline had been left at 1980 instead of imposed for 1975 that the industry, or any portion of it, had on the drawing boards any plans to utilize alternative engine systems as the answer to the 1980 deadline?

Mr. RUCKELSHAUS. Mr. Chairman, we have to look at two things here: One is what they were doing and what they claimed they would have done had the deadline been something else. There is simply no way I or anyone else can assess what they would have done had the deadline been 1980. I think there is validity to the claim that the short time frame, if not in fact, at least based on their experience and the way they always proceeded in the past, led them to attempt to clean up the internal combustion engine.

I think, in fact, there probably wasn't sufficient time to phase in entirely new technology. My own feeling was that given the validity of this claim, I found no evidence that had the deadline not been there there would have been the shifting of the moneys spent to clean up the internal combustion engine into some alternative power source.

I think the reason is that unless there is some standard, governmental standard, against which all of the industry must compete to achieve, in order to achieve some social benefit, they simply are not going to do it because of the competitive aspects of the industry, itself. The inital cost of the automobile is so important in the determination of what their competitive position will be in the industry that the technology that achieves the social purpose that doesn't give them any competitive advantage is not going to be pursued very vigorously. I think that is the reason why the Congress or the Government at some level simply has to set these standards in the public interest against which they all must compete to achieve.

Senator MUSKIE. One of the critical elements in developing a solution to this problem is the attitude of the industry. If there was an evidence over the last 15 years that it had a real sense of urgency, real commitment, dedicating its resources, know-how and expertise to the solution of this problem, you and I would be faced with a different kind of decision.

Let me make this point: The time frame within which the industry had to operate didn't begin in December of 1970 when the Clean Air Act was signed into law. It began no later, surely, than November of 1969 when the White House laid down the policy which I have described earlier today. But beyond that I think it is relevant, since we are getting the record clear, to show the activities or lack of activities of the industry from 1953 to 1970.

There was placed in the Congressional Record on May 18, 1971, what was described as a confidential memorandum of the U.S. Department of Justice.[7] This memorandum recommended to the Attorney General that criminal charges be brought against the American auto manufacturers for conspiring to retard the development of a smog-free motor vehicle. This memorandum, which spells out in detail previously undisclosed evidence, was prepared before January 10, 1969, when the Department of Justice decided to proceed with a civil suit. That civil suit was settled on October 29, 1969, a month before the White House meeting I referred to earlier, by a consent decree entered in the U.S. District Court for the Central District of California.[8]

That consent decree enjoined and restrained each defendant, which included the Automobile Manufacturers Association, General Motors, Ford, Chrysler, and American Motors, enjoined them from conspiring to prevent, restrain or limit the development, manufacture, installation, distribution or sale of emission control devices.

That action was based in part upon a cross-licensing agreement that was entered into, by the industry on July 1, 1955, and which was described in the confidential memorandum to which I have referred in these words:

> In sum, although various approaches to the motor vehicle pollutants emissions problems have shown considerable promise, the automobile companies apparently have done little with it. It seems likely that the reason for this attitude is the fact that the AMA cross-licensing agreement placed the automobile producers in a position where they did not have to fear that a competitor would develop an effective device or system for its exclusive use which might become required equipment and thus put the others at a competitive disadvantage.

That confidential memorandum discloses that:

> In the late 1950s Ralph Heinz, inventor, developed and patented a stratified charge engine which reduced hydrocarbon, carbon monoxide and oxides of nitrogen emissions while at the same time effecting a savings in gasoline consumption.
>
> Moreover, the stratified charged engine would replace the conventional engine with little or no additional cost to the consumer. The development of this engine was published generally so that the automobile manufacturers knew of the existence and what it would do.

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[7] The memorandum may be found at p. 445, appendix.
[8] The consent decree referred to appears at p. 457, appendix.

That is in the late 1950's.

Is the argument credible that they did not have time after the Clean Air Act of 1970 when the evidence is that they had time beginning in the late 1950's, to begin developing the stratified charged engine which now Honda would put on the American market to meet the 1975 deadlines enacted by an American Congress?

I know that in the strict legal sense the question of good faith, I suppose, cannot go back to events of the 1950's or 1960's since the law became effective in 1970. But, nevertheless, in examining the attitude of the manufacturers, whether or not they really had the sense of urgency, isn't it relevant to look into that history?

Mr. RUCKELSHAUS. Senator, I think your recitation of the history points up two things in my mind. One is that because of the importance of initial cost of a motor vehicle emphasized by the automobile companies themselves, we are unlikely to see, over, technology developed that seems to give them no competitive advantage over another company and that achieves a given social purpose, such as clean air. The only way we are ever going to achieve an impetus toward that kind of technology is precisely the way the Clean Air Act of 1970 has sought to achieve it. One might argue about whether that was the best way to do it or not. But the principle of setting performance standards against which all of them must compete it seems to me is unassailable in terms of giving the kind of impetus necessary for them to achieve these standards, for them to develop new technology. Otherwise, there isn't anything in it for them on the basis of which they view their corporate purpose, to develop alternative technologies.

Secondly, I think probably the existence of the 1975 standards is going to do more to stimulate new technology in 1980 than anything else we have done. Instead of saying, "Well, if we had set that off until 1980 would we have had more technology," in effect, probably the opposite is true. I believe it is because of this principle that unless as a society we say this is what must be done by a given industry to achieve acceptable levels of emission to protect public health, they are not going to do it on their own. Even if one of the companies was with the best of intention, and the corporate president said, "I think we ought to produce an engine that doesn't pollute as much in order to protect the public and not worry about profit," I don't think he could get away with it. They would say, "Our competitors will not do that. We may have a car that wouldn't drive as well, that would cost more." They wouldn't let him do it. The only way you can force him to do it is to set a standard that everybody must meet.

Senator MUSKIE. I think the combination of statutory mandates may work. I was interested in that aspect of your rationale in your decision in California. What is the market for Honda cars in California? Do you have any figures on that?

Mr. RUCKELSHAUS. They said at the hearing that they intended to sell 250,000 out of 500,000 of their stratified charged engine in the United States in 1975.

Senator MUSKIE. I can just read those Honda advertisements in 1975. They will come into California saying:

> Well, we are meeting the requirements of your law and your automobile companies are not. Buy a Honda. You don't have to worry about the future. It is clean. It meets the standards. Your cars do not.

I may be in California, where maybe the marketability of a Japanese car is greater than other parts of the country, that you have picked an interesting place for an interesting test. Certainly if I were Honda I would develop that pitch. I am sure they can do it better than I can. I am not an advertising specialist or a PR man. It seems to me that the American automobile industry in the face of this record—really, people who are interested should read the consent decree and the confidential memorandum in full. Here is a record of 14 years of foot-dragging by this industry on this problem, documented by a memorandum of the Department of Justice, and reflected in the consent decree.

It was entered into by the parties, the defendants, and they wouldn't have entered into it if there weren't substance to the charge.

With that record, Honda could make a great sales pitch in California. It will be interesting to see whether they do. Maybe Honda can do more to get the American automobile industry in line than the U.S. Congress can. It will be interesting to see.

We have gone 10 minutes over our deadline. I suspect tomorrow we will get into some of these questions even more deeply and thoroughly. We will meet at 9:30 instead of 10 to give us more time.

[Whereupon, at 12:40 p.m., the hearing was recessed, to reconvene Tuesday, April 17, 1973, at 9:30 a.m.]

DECISION OF THE ADMINISTRATOR OF THE ENVIRONMENTAL PROTECTION AGENCY REGARDING SUSPENSION OF THE 1975 AUTO EMISSION STANDARDS

TUESDAY, APRIL 17, 1973

U.S. SENATE,
COMMITTEE ON PUBLIC WORKS,
SUBCOMMITTEE ON AIR AND WATER POLLUTION,
Washington, D.C.

The subcommittee met at 9:30 a.m., pursuant to recess, in room 4200, Dirksen Office Building, Hon. Edmund S. Muskie (chairman of the subcommittee) presiding.

Present: Senators Muskie, Randolph, Buckley, and Domenici.

Senator MUSKIE. The subcommittee will be in order.

I thought I might begin this morning's hearings by reading a few excerpts from a commentary by an expert in this field by the name of Russell Baker.

It is a column entitled "The Can't-Do Guys." It reads in part as follows:

> WASHINGTON. APRIL 16.—Those of us who were brought up with absolute faith in the absolute superiority of American mechanical skills cannot help feeling embarrassed about Detroit's performance in this matter of exhaust pollution standards.
>
> It isn't that the engineering failure is so humilitating, although it is bad enough when we read that Japanese industry can already meet standards Detroit says it will still be unable to measure up to by 1975. The Japanese! To anyone whose psyche is rooted in the 1930's, finishing behind the Japanese in a manufacturing exercise is like John Wayne being beaten up by Smiley Burnett.
>
> Still, that could be tolerated. We are older now than we were in 1939, and we have learned that nobody can win them all. What is insufferable, however, is that Detroit should not even be ashamed of itself—indeed, that far from being ashamed of itself. Detroit should mount a loud lobbying operation in Washington to call world attention to its defeat.

I thought that might be a good morale booster for the automobile industry on this second meeting of these hearings.

[The article referred to follows:]

[From the New York Times, April 17, 1973]

THE CAN'T-DO GUYS

(By Russell Baker)

WASHINGTON, April 16—Those of us who were brought up with absolute faith in the absolute superiority of American mechanical skills cannot help feeling embarrassed about Detroit's performance in this matter of exhaust pollution standards.

It isn't that the engineering failure is so humiliating, although it is bad enough when we read that Japanese industry can already meet standards Detroit says it

will still be unable to measure up to by 1975. The Japanese! To anyone whose psyche is rooted in the 1930's, finishing behind the Japanese in a manufacturing exercise is like John Wayne being beaten up by Smiley Burnett.

Still, that could be tolerated. We are older now than we were in 1939, and we have learned that nobody can win them all. What is insufferable, however, is that Detroit should not even be ashamed of itself—indeed, that far from being ashamed of itself, Detroit should mount a loud lobbying operation in Washington to call world attention to its defeat.

For months it has been declaring that the American car industry absolutely cannot under any conceivable circumstances solve the hard engineering problem put to it by the Government. What it wanted, and what it got last week, was Government permission to be excused from having to solve that problem for a long time—forever, some people suspect.

What's wrong out there in Detroit? They seem to have lost the good old American know-how, forgotten how to cut the mustard, misplaced the moxie.

This, at any rate, is what they keep saying in Washington while trying to persuade the Government to make it easier for them. At times the force of their lobbying campaign suggests that Detroit may even be proud of its inadequacy.

What a falling off is this. We hear it and think of the Seabees in World War II. The difficult they did immediately. Remember? The impossible took a little longer.

There were can-do guys in those days, and there used to be can-do guys in Detroit, too. America was full of can-do guys not so long ago.

Nowadays we have can't-do guys. Washington is perpetually filled with them, all looking for a Government handout, or a back-door appointment at the Justice Department, all leaning on the Congress and Pentagon and White House while their superb lobbying machines boast that they can't build an airplane, can't run a railroad, can't stop dumping their garbage in their own life's air.

Inability to get results back at the plant doesn't seem to matter anymore. Nowadays, to get results you go to Washington.

Can't-do guys do all right in Washington, perhaps because lobbying is one thing the can't-do guys almost always can do, and magnificently. Detroit may not be able to dispose of exhaust very neatly, but it can build a beautifully lobbying machine for selling Government the story of its own inadequacy.

What is it in the Washington air that restores the energies of these once dynamic American manufacturers? Something there is that brings out all the old latent, half-forgotten ingenuity that seems to have abandoned them back in the home plant.

Back in Burbank everything may seem hopeless. Engineers weeping and test pilots refusing to take the thing off the deck. But bring them to Washington and, suddenly, hopeless, half-dead men are leaping on the cocktail tables in $650-a-day penthouse suites shouting, "I don't care how impossible it looks, boss! Our lobby can lick this problem!"

Production, of course, counts for little in Washington. Here salesmanship, not production, has become the ultimate virtue. This is why companies that can't produce at the plant do it so well in Washington. The test here is seldom whether it will work, but whether you can sell it. And so long as you can sell it, who cares whether it works or not? Salesmanship—that's the stuff. In Washington, even corporate failure sells is boasted about loudly enough.

To get results in Washington, as Pentagon contractors have known for years, you have to have good old American don't-know-how.

Senator MUSKIE. Mr. Ruckelshaus, I think yesterday's hearing was a useful and helpful one. I understand that you would like to begin this morning's with a statement on the NO_x problem and if you will proceed in your own way.

STATEMENT OF HON. WILLIAM D. RUCKELSHAUS, ADMINISTRATOR, ENVIRONMENTAL PROTECTION AGENCY; ACCOMPANIED BY DR. STANLEY GREENFIELD, ASSISTANT ADMINISTRATOR FOR RESEARCH AND MONITORING; AND JOHN FINKLEA, DIRECTOR, NATIONAL ENVIRONMENTAL RESEARCH CENTER, RESEARCH TRIANGLE PARK, N.C.

Mr. Ruckelshaus. Thank you, Mr. Chairman. As I indicated yesterday I would like to discuss the problem of nitrogen oxides today. Accompanying me are two gentlemen with whom I would hope most of the questions would be directed are Dr. Stanley Greenfield, who is the Assistant Administrator for Research and Monitoring, and the primary science advisor within the agency to the Administrator, and Dr. John Finklea, who is the Director of the National Environmental Research Center at Research Triangle Park in North Carolina. This center is one of four National Environmental Research Centers that we have established that deals primarily with health effects.

Both of these gentlemen have impressive backgrounds. Dr. Finklea is an M.D., Dr. Greenfield has his Ph. D. in meteorology and both of them have a long background in dealing with the health effects of various pollutants, particularly air pollutants and I think they can provide to the committee the best testimony that our agency has as to the health effects of the various pollutants that we are dealing with today.

They do have a presentation to make with some charts indicating some additional information.

I would like to start off by making a short statement.

The 1976 motor vehicle emission standard requires a 90 percent reduction in nitrogen oxide emissions calculated from an uncontrolled vehicle. The requirement of that standard is interwoven not only with the other motor vehicle control requirements of the act, but it is inextricably linked to the national ambient air quality standards. In our consideration of the 1976 nitrogen oxide standard we must not lose sight of the overall context, which includes the national ambient air quality standards.

The ambient standards are premised upon an administrative determination of fact, i.e., what are the limits of constituents of ambient air beyond which health and welfare will be impaired. On the other hand, the motor vehicle emission standards are legislatively fixed and designed as necessary steps toward the achievement of the national ambient air quality standards.

First of all, there is the question of how the health-related national air quality standard for nitrogen dioxide was derived. This standard was set at 100 micrograms per cubic meter as an annual average. The national standard itself was based largely on the results of 1968-69 study on the occurrence of respiratory illness among school children in Chattanooga.

The air quality reference measurement standard used to monitor the levels of exposure in Chattanooga has since been shown to be unreliable for general use. When this became apparent last year, we initiated a reappraisal of the Chattanooga results using air quality data gathered by another measuring method in Chattanooga during a period just prior to, and somewhat overlapping, the start of the study of schoolchildren.

The nitrogen dioxide standard, therefore, is open to some question, but the uncertainties about it are all in a direction which indicates that it does adequately protect public health. We have, of course, inaugurated the necessary epidemiological, clinical, and laboratory studies to gain additional knowledge on both the long- and short-term effects so as to enable us to make a determinaton on whether any revision in the standard is warranted.

Dr. Greenfield will dwell at some greater length on just what that necessary research effort is.

Next, there is the question of the degree of nitrogen oxides control needed for attainment of the national standard. Our initial judgment on the extent to which the national air quality standard was being exceeded was based on measurements made with the same method used in the Chattanooga study. During our review of State implementation plans, State air quality control officials brought to our attention their belief that the reference method we had recommended was in error.

At that time we called this to the attention of the staff of this committee and of the House Subcommittee on Public Health and Environment and further advised those staffs of our intention to attempt to verify the reliability of the method. This was last summer.

Over the past year, therefore, we have been measuring nitrogen dioxide levels by various measurement methods at some 200 sites across the country, including sites in the 47 air quality control regions where we originally believed that the national standard was being exceeded. A full report on this study will be available very shortly.

As indicated in my testimony, February 28, 1973, on the House side, on extension of the Clean Air Act and before other groups, nitrogen oxides may not be the problem we and this committee once thought they were.

Our study shows that there are just two regions—Los Angeles and Chicago—in which nitrogen dioxide is a significant problem. It is expected that the measures to be taken to deal with the photochemical oxidant problem in Los Angeles, will also solve the nitrogen dioxide problem.

Further, in the Chicago region, we estimated that the current Federal motor vehicle standards, coupled with transportation controls required to meet the oxidant and carbon monoxide standards for this region, will be adequate. To obtain the standard by 1975 elsewhere, it is clear that major cutbacks in nitrogen oxides emissions clearly are not necessary at this time and will not be necessary during the next several years. Moreover, the exact level of nitrogen oxides control required to ensure continuing maintenance of the national standard cannot, at this time, be well defined.

Given these circumstances, the Environmental Protection Agency shortly will reclassify all the air quality control regions, except Los Angeles and Chicago, which originally were judged to exceed the health-related standard. The effect of this reclassification will be to remove requirements for adoption of a control strategy for nitrogen oxides. States that have already adopted such a control strategy will have the option of modifying it. And in cases where the Environmental Protection Agency had proposed regulations to control nitrogen oxides emissions from stationary sources, the proposals will be withdrawn.

As for motor vehicle emissions, a 90-percent reduction in nitrogen oxides is, in my judgment at this time not necessary. We are undertaking further analysis to determine exactly what such a standard would be. Given the need for this further analysis, coupled with the ongoing studies of the health effects of nitrogen oxides, it is my judgment that a new nitrogen oxides emission standard should not be legislatively mandated, but rather that the Environmental Protection Agency should continue setting the standard under the provisions of section 202(a) of the Clean Air Act, in lieu of the present requirement for a 90-percent reduction in 1976 under section 202(b). We have drafted an amendment which would accomplish this purpose and request that it be considered by the committee.

This concludes my prepared remarks, Mr. Chairman. I would be happy to answer any questions you might have.

Mr. Chairman, I do not make a statement like this lightly because I believe it is very important before this committee to change any such legislative mandate standards as applies to nitrogen oxides, that there be a full public hearing of what we are recommending.

Starting last summer and intensifying in the late fall and early winter, I several times, as did the Deputy Administrator, Mr. Fri, made statements to the same effect as it made in this statement before congressional committees and in various public presentations.

The impact of those statements was I think to say the least largely ignored or missed by the public and it is for that reason that I would recommend and will carry out the recommendations myself that we publish not only this statement, but the analysis behind it which has led us to this conclusion, in the Federal Register requesting the public over a period of time, say 30 to 60 days, to comment on this analysis and give us the benefit of the best scientific advice we can get outside of the Agency and from the public at large as to whether our analysis in fact is correct.

At the end of that period of time, I think these comments should be forwarded to the committee along with this continued recommendation if our further analysis warrants that for whatever action the committee would want to take.

There is some degree of urgency that this matter be considered by the committee because where the nitrogen oxide levels are finally set has a tremendous impact on the kinds of technology that can be available to control hydrocarbons and carbon monoxide.

So I think we ought to set a schedule for consideration of this problem with some degree of urgency so that there can be a signal given to the automotive industry as to precisely what standards they have to meet, and what they should shoot at.

For that reason, I am recommending since we have not been able to generate very much public comment by any other method that we have adopted that we do publish this in the Federal Register and request public comments which, of course, will be made available to the committee.

Senator MUSKIE. I am sure there are a lot of questions on the part of the committee. Would you like to proceed with the presentation of the Doctor?

Mr. RUCKELSHAUS. Yes I think it would be beneficial to the committee to see what has led us to this tentative conclusion and the analysis that lies behind it.

Senator MUSKIE. Let me ask just two questions, then.

Maybe these will help lay the basis for their presentation. Once you spoke of an analysis that you would publish in the Federal Register. Is that analysis now available? Is this the analysis they are going to make?

Mr. RUCKELSHAUS. This is in summary form the analysis. We do not have a document that is presently ready to be published in the Federal Register. We do have an almost completed document on the measurement problem itself; that is obviously an integral part of this analysis.

That along with the conclusions that has led us to this is what we will publish and we will, of course, make that available to the committee also.

Senator MUSKIE. Will there be a document describing the analysis at some point?

Mr. RUCKELSHAUS. Yes. There will be.

Senator MUSKIE. When? Can you give us the time on that?

Dr. GREENFIELD. As a matter of fact, Mr. Chairman, I think a preliminary document which covers most of the points on the measurement analysis has already been made available to your staff.

Senator MUSKIE. Is this the one that you pointed out to me earlier this morning?

Mr. RUCKELSHAUS. No. That is not. That is a different document.

Senator MUSKIE. This is the assessment of the analytical document available for the determination of nitrogen oxide and ambient air.

Dr. GREENFIELD. That is right. That is the one prepared on February 24. It is being updated. It is the basis for the measurement portion of the analysis.

Senator MUSKIE. The second question I would like to ask refers to your statement in which you say that over the past year we have been measuring nitrogen dioxide levels by various measuring methods at some 200 sites across the country, including sites in the 47 air quality control regions where we originally believed that the national standard was being exceeded. A full report on this study will be available very shortly.

Is that full report essential at all to the conclusion which you have stated here in this statement this morning?

Dr. GREENFIELD. Yes. It is because if those measurements which lead you to what we might call a reclassification of the 47 air quality regions.

Senator MUSKIE. Does the fact that the Administrator has reached his firm conclusions as stated this morning indicate that he has had access to essentially all of that information?

Dr. GREENFIELD. Yes. He has.

Senator MUSKIE. So the preparation of the report is simply a matter of typing and putting it in form. The substance of that report is in part the basis of your conclusions this morning?

Mr. RUCKELSHAUS. Yes.

Senator MUSKIE. I will withhold any further questions until we have had the full presentation. Do other members of the committee have questions?

Dr. GREENFIELD. Because of my close quarters, I wonder if it might be better if I remained seated, and you can all see the charts?

Senator MUSKIE. I think that would be fine.

Dr. GREENFIELD. The first chart described is the four basic methods that have been considered. The first is a Federal reference method, four columns, the sampling technique used there is a 24-hour bubbler. That means whether or not it happens in 24 hours or whether it is continuous measurement, which means you take measurements every few minutes during the day.

This third column is the question of whether or not this method had been field tested when the standard was set. The fourth column is a set of remarks which I will get to.

The first row is the current Federal reference method, the so-called Jacobs-Hachheiser technique. It is a 24-hour bubbler. It had been field tested when the standard had been set, but we did not know at that time of a problem that cropped up subsequently relating to the collection efficiency. At the time that method was set——

Senator MUSKIE. When was that time?

Dr. GREENFIELD. This was the time just prior to the setting of the standard itself and the publishing of that method as a standard reference method.

Senator MUSKIE. Was this before 1969 or 1970?

Dr. GREENFIELD. 1971; 1971 officially.

Senator MUSKIE. After the enactment of the legislation?

Dr. GREENFIELD. Yes; but in setting up this as the Federal reference method, it was assumed that it had a 35-percent collection efficiency which was constant across all concentrations.

The Griess-Saltsman method is a continuous sampler. It too was tested at the time. It was the one used in the camp stations and the Chattanooga abatement studies. It does not give reliable measurements at low levels of NO_x and oxidants and others may be a problem. The third method is the so-called arsenite bubbler. There are several versions of that. They too are 24-hour bubblers. They were not field tested at the time the standard was set. However, they do appear to have a stable collection efficiency over a wide range of NO_x concentrations. There may be some interferences but they are not yet completely contemplated. It appears to be relatable to the Saltsman observation. That is a very key point.

The fourth method is the so-called Chemluminescent method. It is a continuous method. It had not been tested at the time of the standards. It avoids the drawback of wet chemicals. There is an additional field testing now underway. It has the ability of providing short-term air quality standard measurements.

To get at the moment of the problems of the collection efficiencies, this is a graph which plots up the side collection efficiency or overall efficiency and percentage and along the bottom concentrations of nitrogen dioxide sampled. On the bottom it runs 30 micrograms per cubic meter to 750, certainly covering the range of our interest. The collection efficiency runs from zero up to 80 percent. The dotted line running across the chart horizontally is the 35 percent assumed constant collection efficiency applied to the Federal reference standards. The curve starting at a little above 70-percent efficiency and running down to just above 10 percent efficiency at the high end of the NO_x concentration is the actual collection efficiency that we have now determined with this view.

This means that at the low end of the concentration where the curve goes above the dotted line, you are over estimating the concentrations of NO_x in the atmosphere. Below the dotted line you are underestimating it.

Faced with that is a problem we decided we had to find out what we could do to recover or hold on to the data we had which underpins the standard that had been set.

Fortunately, at the time that the measurements were being made with the Federal reference standard in Chattanooga for which the health data was available, there was a small overlap period with the Saltsman measurement technique 1 month.

What we did was go back and take the sampling by the Saltsman method and compare it with the samples or the concentrations that had been determined by the Jacobs-Hochheiser method. At the levels we were measuring in Chattanooga at that time, namely about 100 micrograms per cubic meter, we found a fair amount of agreement between the Saltsman measurements and the Jacobs-Hochheiser which gave us some degree of assurance that the level, approximately the level we had set for the observable health effects, was about right, namely about 100 micrograms per cubic meter.

I can't emphasize enough the fact that in no way does this remove the feeling and assurance that we have that there is a health-associated effect due to NO_x. What we are talking about now is exactly where you set that standard and whether or not the data we had was usable in setting the standard and what it allows us to do today.

Senator Muskie. Could I ask a question or two to clarify in my own mind what that means?

Are you saying that the levels of concentration of nitrogen oxides that relate to healthy effects is the same now in your judgment as it was in 1970 or different?

Dr. Greenfield. No; I am saying that the level that we set the standard at, approximately 100 micrograms per cubic meter, which were related to health effects noted in Chattanooga, has not changed. There may be a degree of uncertainty as to exactly what that number should be, whether it should be 90, 100, or 110 or what have you. But the approximate level has not changed and the degree of uncertainty is primary in the degree of uncertainty associated with the various instruments that we have and how they relate one to the other. At the level of about 100 micrograms per cubic meter, at about the level we set the standard, we know that the Saltsman measurement would have a degree of confidence at that level that just about matches the Jacobs-Hochheiser. So we know that at that point at least the two instruments were reading about the same.

The next question is, that is the one I will get to now, is can I go out into the field where I have a large number of measurements and find a measurement system that I can use which matches with the Saltsman?

The method that we have in the field right now is the arsenite bubbler. Its collection efficiency is shown on this chart. We have a fair degree of confidence now that over the range of NO_x concentrations that we are interested in, its collection efficiency remains essentially constant.

Senator MUSKIE. It is about 85 percent?

Dr. GREENFIELD. About 85 percent. The difference between the circumferential and the triangle is the difference between the type of orifice or frit that you put on the instrument. The question was how well was the Saltsman measurements with the arsenite bubbler measurements. That is the next chart.

We have a set of monitoring stations, Chicago, Cincinnati, Denver, and so forth. The second column is the measurement at these stations, annual averages, measured with the Saltsman continuous instrument. The third column is the same type of measurement, measured with the arsenite bubbler corrected for that 85 percent collection efficiency and the fourth column is the ratio of the Saltsman to the arsenite corrected.

As you can see in the vicinity of about 100 micrograms per cubic meter, 75 to 100, the Saltsman and the arsenite give about the same answer. The ratio is between 1 and 0.9 or thereabouts.

The one measurement that is bad is in the California 841 where we know we had a bad arsenite bubbler. But when you are talking about measurements, in the vicinity of the standard we know the arsenite bubbler and the Saltsman are giving approximately the same answer.

What we are looking for is where do we approximately draw the line and has that changed when we look at our air quality control regions?

We also wanted to look at what the relationship might be between the Saltsman continuous and the chemiluminescent method. Once again looking at a set of stations and we have now drawn the second column, Saltsman continuous, chemiluminescent, and now the ratio of Saltsman to chemiluminescent, we find once again in the range of the standard, the current standard, the Saltsman and the chemiluminescent gives us approximately the same answer.

If we go now and look at the levels of measurements or the values that are associated with the various measuring techniques at the 47 air quality control regions, we have the following chart. I don't know whether it is completely readable, but the AQCR are listed on the far left column. The next column are the measurements done by the Jacobs-Hochheiser instruments. The third column are those from the arsenite. The fourth column are the chemiluminescent and the fifth column are the number of days, and as you see, there are fewer than a years' worth of data because we have not had the chemiluminescent in the field.

The fifth column is the suggested priority classification. Priority one being those regions that require control, priority three those that do not require control.

As you can see, around 100 micrograms per cubic meter, we find that there are two areas under the measurements and realizing uncertainties that exist, there are two regions, Los Angeles and Chicago, both of which with the Saltsman, chemiluminescent and the arsenite all fall above 100 micrograms per cubic meter. There are a number of them, some 43 that fall definitely below.

The way we look at this, if both the arsenite and the Saltsman. gave measurements that were above the 100 microgram per cubic meter, we considered those as being necessary to put in region 1. If both measurements gave readings that were below the 100 micrograms. we have put them in priority 3.

There are two. Salt Lake City, Utah, and Denever, Colo., where the arsenite gives below, but the Saltsman gives above. We felt they require additional studies. The chemiluminescent also gives at about 100.

We felt that based on the fact that there was this question, because the two measurements disagreed in terms of whether or not you are above the standard or below, we felt that those should be given further study. Those in the category of pending further study.

Senator MUSKIE. At this point, the issue seems to me to be this: That you are concerned not so much about the standard that relates to health effects as to the concentration of ambient air in these areas, with respect to that standard.

Dr. GREENFIELD. That is correct.

Senator MUSKIE. So the question of measurement isn't as to the setting of the standard, but as to the actual condition to be found in the ambient air in these places of whether or not they are above that standard.

Dr. GREENFIELD. That is correct.

Senator MUSKIE. So what you conclude in this chart is that the health effects standard has not changed, but when the health effects standard is applied to these areas you find now, with these new measurement techniques, that only two areas are at or about at the standard in ways that require control?

Dr. GREENFIELD. That is correct. This is with the caveat that because of the measurement problem still more work is required on accurately setting that standard, the ambient air quality standard. We know there is a health effect.

We know that in all probability the 100 micrograms per cubic meter is a conservative determination of what that standard should be because if you go into the Chattanooga area, there has always been the question of whether or not the health effects were due to just nitrogen oxide or were due to acid mist or a combination of several things. By assuming that they were primarily due to nitrogen oxide, due to other things we saw, you are on the conservative rather than the optimistic side.

Senator MUSKIE. So you are not proposing liberalizing the standard which tells us at what concentrations there are ill effects?

Dr. GREENFIELD. We are not proposing to liberalize the ambient air quality standard at this time, that has been set right now, although we admit and we will lay out for you the research program that is underway, to pin down more adequately exactly what that number should be.

Senator MUSKIE. So that number is still at or about 100?

Dr. GREENFIELD. At or about 100. That is correct. As a matter of fact, to go back to what the Administrator said about the automotive standard, we have certainly the condition where many fewer air quality control regions require nitrogen oxide control now than we suspected, even a relatively short time ago.

We also have the condition that when we look at the possible range of values that the nitrogen oxide ambient air quality standard can take, maybe 90, maybe 110, 150, which we are trying to pin down, that over that range we find no real value that is larger than where we currently are with nitrogen oxide, auto emissions, the 3.1 grams, and the range of values going from there to higher percentages. So there is even uncertainty now as to where the automotive emission is more substantially set going from where we are now toward 90 percent. That is why the question is raised as to whether or not we want to hold back on that until we have pinned down exactly what the numbers should be.

This is the chart relative to the Chattanooga data and to the other stations in the country. Above the line drawn across the chart are values that are measured with the Saltsman technique in the Chattanooga area. Below the line are the values using the arsenite bubbler.

I think the interesting thing about the above-the-line thing is it bears out what I said about the comparability of the Saltsman technique and the Jacobs-Hochheiser measurement at about the level of the standard that we set.

As you see at higher exposures using the Saltsman technique we have 276 micrograms per cubic meter, at intermediate exposure, 150, and in the control area, where you saw no health effects, 75, which means you want to set the standard, the threshold, somewhere between 75 or 150, probably in the vicinity of about 100 micrograms per cubic meter.

Once again as we go down below that into the arsenite bubbler data, Chicago and Los Angeles stand out being primarily above the values of 100, New York being just at the border line, Baltimore-Washington being somewhat below this is where you draw the line right now.

The question is raised as to whether or not the health effects that you observe in Chattanooga are due solely to NO_2 are also included effects of nitrate and sulfates, we wanted to compare the nitrate and sulfate concentrations that you see in Chattanooga with what you see in the rest of the country.

You see that it indeed is a problem across the country. It is not contained just in Chattanooga.

Senator Muskie. Which means that you don't need to discount the Chattanooga measurements for that fact?

Dr. Greenfield. That is right. You will find the same sort of thing approximately occurring across the country.

I think what we will do now, I will turn the floor over to Dr. Finklea, who will discuss the health effects data and the research program.

Dr. Finklea. Thank you, Dr. Greenfield.

I want to present you three charts here which will illustrate what knowledge was available at the time the criteria document was written for nitrogen oxides, what information we have gathered since that time and what the research program today in like and when we expect results from that program.

I have arranged these effects in the first column into those which could be likely to be expected from exposure to gaseous or particulate pollutants, in this case, oxides or nitrogen. We then have two kinds of human studies in the next two columns, one the epidemology or community studies and the second clinical research which may involve accidental exposure or exposures to very carefully controlled low levels by human volunteers.

In the last column we have toxicology studies or studies involving experimental animals.

The experimental animal models for human disease are not perfect but we can look at certain indicators of these diseases in the experimental animals. We have limited our experimentation here to toxicology studies done at reasonably low levels, less than five parts per million.

You will see also two orders of magnitude greater than the present ambient air quality standard.

The first effect you might be concerned about is the increased susceptibility to the acute respiratory disease. At the time we had a single study in Chattanooga, no data from any clinical research and had some animal studies that showed that nitrogen dioxide alone can cause the effect in experimental animals at levels which were between 10 and 50 times that which were advocated by the standard. This is not an unusual safety factor in many kinds of toxicology.

The next effect was increased severely in acute respiratory disease. Once you become affected did you become in fact sicker? We again had a single, unduplicated study in Chattanooga and one study involving rodents.

So we had a consistent result here across two experimental approaches. We also were concerned about the increased risk of chronic respiratory disease, chronic bronchitis, and emphysema. We had a single study in Chattanooga which showed a worse finding of decreased lung function but certainly no clear evidence of chronic respiratory disease. We did have antidotal case reports involving people who had suffered massive accidental exposures to nitrogens and oxides. They did have trouble. We had studies in animals that suggested this effect did occur at levels which were between 10 and 50 times the present primarily ambient air quality standard.

We were concerned about aggravation of asthma, about the aggravation of preexisting heart and lung disorders. These are susceptible or vulnerable groups of the population and we had no information.

We were also concerned about nitrates that might through a very complicated process be converted to carcinogenesis, cancer causing chemicals. The nitrate, nitride, is one that crosses water pollution, air pollution, and problems with food additives.

I want to go further into that right now. As you can see, these were limited series of studies on which to set a national primary standard for every important pollutant. We have been busy since that time, about 2 years.

Again, taking the same effects you can see we have had a second study and demonstrated again that exposure to oxides and nitrogen can result in increased severity of respiratory disease, we have had additional animal studies, and we have had one study in which we looked for chronic respiratory disease in adults living in Chattanooga and did not find it. This was after exposure to elevated nitrogen oxides levels for 3 years.

We have had one study in which we can look at the aggravation of asthma and find a suspended particular nitrate which arises from oxide of nitrogen and are relatable to this disorder and we do not have studies on the last two effects that we are concerned about.

Our existing research program is intended to fill some of these gaps where there are approaches that can be utilized. I won't go into each particular study that is planned. But you can see that between now and the end of fiscal year 1975 we hope to have a much improved health effects data base for control of this very important pollutant.

You will also see we are only able to just begin to approach the problems of carcinogenesis and the aggravation of chronic heart and lung disease. The cancer-causing problem is one that extends across several agencies in the Federal Government who will be working on it. It is not, of course, solely the EPA.

If we are to look at the present status of our knowledge of oxides and nitrogen, we will come up with the next chart.

In this case we are taking each one of the effects for which we have information now. We are showing you the research approach that was used to get that information and we are giving you three estimates, a worse case estimate which would say at worse nitrogen dioxide at this level may be causing an effect.

A least case estimate in which we say, after we take into consideration a number of our uncertainties, we think that this level could certainly cause an ill effect. Then from a team of scientists concerned about this a best judgment estimate. The intent here is to define the arena for disagreement and to give best judgment from one group of scientists, in this case the scientist within EPA.

We also are giving you the duration of the exposure that we think is important. As we go through this very complex series of effects, we therefore give the decision maker a range of effects, values, and also allow the discussion of any one particular effect in this importance.

I think there is one thing that should be brought to your attention here, or two things, really, one is the epidemiology study we are speaking of here with one exception are still dependent upon the Chattanooga experience and the second is that our animal studies and our real analysis in Chattanooga leads us to believe that repeated short-term peak exposures to oxides and nitrogen are, in fact, at least detrimental than a continuous annual average exposure.

If we were concerned about the repeated short-term peak exposures, our existing information suggests that we should be concerned about exposures for roughly 10 percent of the hours in any 1 year, this amounts to 2 or 3 hours per day, to respond to peak exposures that could occur because of peak changes in traffic or other factors which favor the formation of nitrogen dioxide in certain areas of the country.

We have these three estimates in which we would think, based on our present appraisal, that effects could occur with levels as low as 188 micrograms per cubic meter. This is for so many hours.

For a least case estimate, we would have a very broad range, if we were to omit any consideration of the Chattanooga experience, you see we are dealing with 940 micrograms per cubic meter. If in fact we continued to accept the Chattanooga experience, we are in the range of between 188 and 376 micrograms per cubic meter.

Our best judgment is 282 micrograms per cubic meter and a suggested option including a safety fact which would take it to roughly 200 micrograms per cubic meter.

In reconstructing the exposures in Chattanooga to take into consideration these short-term exposure variables, we do have to use meteorological models which are plagued with uncertainties up to a factor of two. But this is the best judgment that we have at this present time.

Additional work is being done on this particular problem and prior to the publication of the documents that Mr. Ruckelshaus referred to earlier this result will be available.

One can easily ask what would be the effect of any change in whether you looked at a short-term effect or an annual average effect? What I have done here is using air quality models tried to take the effects threshold in the first column, the three we just talked about, and relate them to maximum hourly values which you would not want to exceed more than once a year, or maximum 24-hour values not to be exceeded more than once each year on the basis of what we know about air quality from the camp stations located in several of our major cities.

I think you can see that the suggested option for the standard based on a short term, of avoiding the adverse effects of short-term exposures works out to be about the same annual average that we have now that has just been extended.

I think our observation here is that the suggested option that we would give you today, if that were our responsibility today, for appraising a standard would not result in a change in the annual average standard, but would result in the addition of a consideration of the effects of short-term repeated peak exposures.

Thank you, sir.

Senator Muskie. These judgments are hard and fast at this point?

Dr. Finklea. No, sir; as I said, these are judgments that we give you at one point in time. The uncertainties related to the exposures we are giving you here in Chattanooga are as great a factor of two. Based upon our previous Hochheiser information which in Chattanooga is not a bad estimate of the annual average of exposure, we would think any changes would be upward and not downward.

Senator Muskie. That is that human health can take higher concentrations than we up to now have assumed?

Dr. Finklea. No, sir; I didn't say that. That would be that the evidence we had from the studies in Chattanooga would mean that the present standard included a larger safety factor than we had previously thought.

We don't have the information to be assured that human health will be completely protected up to a new level which might be twice the present level.

Senator Muskie. That seems to be the direction in which your findings are leading.

Dr. Finklea. That is correct. But we also show here that there are several vulnerable subgroups in the population for which we don't have information. It may be that these vulnerable subgroups will suffer adverse effects at levels shortly above the present ambient air quality standard.

So I don't think we are ready to advocate relaxation at all at the present time.

Dr. GREENFIELD. I think, Mr. Chairman, is what we are saying is just that, if you are forced to live with just Chattanooga data and the uncertainties that exist, if you went anywhere you would push the standard higher.

Senator MUSKIE. More stringent?

Dr. GREENFIELD. No; less stringent; but with a greater safety factor. With the uncertainty, with the fact you have indications from animal experiments that there are these effects, you would prefer to say let's hold a larger safety factor and hold the present standard while we get the information necessary to do what is right.

Senator MUSKIE. If I may summarize, you will have to forgive politicians for always looking for the oversimplification, I want to be sure that the public understands this as well as we understand the significance of what you have told us.

You are not ready at this point to propose a different number as to the health effect standard that we ought to adopt?

Dr. GREENFIELD. The ambient air quality standard. That is correct.

Senator MUSKIE. You don't propose to recommend any change?

Dr. GREENFIELD. At this time. Right.

Senator MUSKIE. What you have told us in your presentation is that there are indications that the number may be higher or, in other words, less stringent when you complete your analysis and have the benefit of the data you think you need? It may be higher?

Dr. GREENFIELD. But it may be a little bit lower, too.

Senator MUSKIE. Is that possibility strong?

Dr. GREENFIELD. I don't think either of us would be willing to state categorically that it is equally probable it is going to be high or low. There is enough uncertainty that you have got to be able to pin these down before you can say categorically at what standard it is. One hundred micrograms per cubic meter is not a bad standard from a conservative standpoint, but it is conceivable as you get deeper into this, when you start looking at the other effect, you may indeed come up with a more stringent one.

Senator MUSKIE. So the emphasis of your present policy is not on the number related to health effects, but rather on the concentration of nitrogen oxide in the ambient air in these various test areas.

Dr. GREENFIELD. Right.

Senator MUSKIE. It is that to which Mr. Ruckelshaus' policy recommendation addresses itself?

Dr. GREENFIELD. Exactly.

Senator MUSKIE. I have taken some time for questions in the course of your presentation. I think in all fairness I might yield at this point to my colleagues.

Senator Buckley?

Senator BUCKLEY. Thank you, Mr. Chairman.

Mr. Ruckelshaus, I am sorry I was not here to hear the presentation of your statement. I have had a chance to read it. I am interested in your view of whether you anticipate at this time that the proposed change of standards that you recommend could be met by the auto industry without the use of a second catalyst system?

Mr. RUCKELSHAUS. Senator, I think a short answer to your question is yes, although we are not at this point recommending that the 90-percent reduction standard of the automobile emissions is no longer justified on the basis of the measurement techniques that we used, but basis of the need nationwide.

We are not saying in effect what the standards ought to be, if it isn't 90 percent.

My tentative recommendation is that we should not forget about the standard. We should not relax the advances that we have already made in controls of oxides of nitrogen in automobile emissions, but with the exception of California where we have already set the number at 2, before we push the number below 3.1 we ought to have some idea, a better idea now than we have, of the need for this nationwide.

If this is true, there is no need for a dual catalyst system on engines using the present, either the California standard of 2 or the nationwide standard of 3.1. And all the fuel penalties that are associated with it.

I might add in passing that most of the astronomical numbers that we see associated with the attacks on the standards themselves relate to the fuel penalty of meeting the 1976 nitrogen oxide standard.

Senator BUCKLEY. Most of all of the attacks. Certainly the National Academy of Sciences pointed up to the fuel problem, but also reliability in the fuel maintenance with its own associated costs. But getting back to fuel economy, you pointed out yesterday in answer to a question of mine that it was that second catalyst which would cause the fuel problem.

I expressed concern, the concern was also reflected in the Academy's study, that your decision might have the effect, as a practical matter, of precluding the other options by forcing this ponderous enterprise known as the Detroit car industry to move in one direction to the exclusion of others.

Do I conclude that you have made a calculated risk that subsequent studies will in fact prove that we can lower the NO_x standard, thereby not necessitating the fuel-consuming second catalyst?

Mr. RUCKELSHAUS. Mr. Stork has pointed out while the reducing catalyst is an effort to clean up the NO_x problem and the component is the exhaust gas recirculation valve and that is the process that causes a good percentage of the fuel penalty, because you have to increase it all of the time.

Senator BUCKLEY. It is a fact that the NO_x standard is met with a catalyst in combination with exhaust gas recirculation that consumes that fuel?

Mr. RUCKELSHAUS. Yes.

Senator BUCKLEY. In your decision-making process, and I would hate to have been in your shoes trying to balance all of these factors, were you in fact considering the likelihood that one could lower the NO_x standard and might make it unnecessary to push the second catalyst? Yet might this not have the result of having headed the industry into a direction which would in fact consume a lot of fuel?

Mr. RUCKELSHAUS. I wouldn't put it exactly that way, Senator. I think what has impelled me, even if all of these penalties are there, if there still was a clear health-related need to reduce emissions by that percentage, I don't think I would be here recommending that this committee consider doing so. But because the justification for the 90-percent reduction standard no longer is there based on our reassessment of the measurement technique, I just can't see if that is true. And given the penalties that are associated with the achievement of that standard, I can't see the public policy reasons for continuing it without more justification than we now have.

The same problem exists with any pollutant that we deal with. You can say, "We don't know what levels a pollutant starts having some healthy effects." That is true for just an enormous number of pollutants.

But from there you don't thereby say: "Therefore, we ought to control those up to a certain percentage point regardless of what the cost to society might be."

If that is the policy on which we are going to try to control pollutants, then we could get into some very enormous costs that we later find for which there are no benefits.

Senator BUCKLEY. If I could summarize, in making the decisions that you made in setting the standards——

Mr. RUCKELSHAUS. Are you talking and CO and HC's?

Senator BUCKLEY. CO and HC's and taking into account that one has to consider the 1975 standards as a prolog to 1976 standards, you have encouraged, if that is the proper word, the industry in moving along in the direction of catalytic systems. Some might say that the practical effect would be to the exclusion of experimenting with the alternatives. But in so doing you do not have the same degree of fear as to the ultimate effect on fuel consumption that is reflected in the NAS report for the reason that you feel that a reexamination of the NO_x standards will in all likelihood result in a relaxation of the standards, thereby not necessitating that next technological step, the second catalyst.

Mr. RUCKELSHAUS. Let me say two things about that. I think my conclusion, although I haven't thought this through in my own mind, would have been the same regardless of where we ultimately end up with the NO_x standard based on the laws as presently written and as I see my obligations under that law.

I do not believe that having moved the standard where we have, which is in effect going to force in oxidation catalysts on many cars by 1976, we are reducing the likelihood of them, the automobile companies investigating other technology. In fact, I think we are increasing that likelihood.

So that would not in my mind weigh on my decision. I do think that as a matter of fact it is probably easier for them to achieve the 1975 HC and CO standard if the NO_x standard is not necessitated by any analysis that we can come up with.

But that in and of itself, if the NO_x standard where to remain where it is now, I still think that there is sufficient need to reduce HC and CO and the only way we can do it is my making these standards ever more stringent up to the limits set by the Congress that my decision probably would have been the same.

Senator BUCKLEY. What impact would a relaxation in the automotive NO_x standard have on the attainment of the national secondary ambient air quality standard in the protection of the public welfare?

Mr. RUCKELSHAUS. There is no secondary NO_x standard. There is only a primary, or health-related standard.

Senator BUCKLEY. Secondary ambient air quality standard.

Mr. RUCKELSHAUS. The secondary is protecting against public welfare, against all known or anticipated adverse effects.

Senator BUCKLEY. My understanding is that one of the problems of the NO_x is that those things that one does to control HC and CO tends to generate the NO_x. If NO_x turns out to be less of a problem than we thought, does this mean that we can move forward more vigorously in the control of HC and CO?

Mr. RUCKELSHAUS. I think it is certainly true with respect to the automobile.

Dr. FINKLEA. I think there are two points here, Senator. First, we do not have a secondary ambient air quality standard for the automotive pollutants primarily, which arise primarily from automotive sources.

Senator BUCKLEY. Automobiles are the principal sources of these pollutants?

Dr. FINKLEA. We do have primarily ambient air quality studies for these pollutants.

The second point would be we are not advocating that the controls of oxides and nitrogen be further relaxed than they are today.

I think that was the question. I don't think one has advocated that relaxation.

Dr. GREENFIELD. I think also what you are asking goes to the question of the formation of oxidants itself and the relation of hydrocarbon and NO_x. There has been quite an extensive analysis of the relationship between hydrocarbons and NO_x and the formation of oxidant.

You have to ask the question which of these you choose to control, which is the most effective way of controlling it. Since the hydrocarbon is predicated on the control of the oxidants, you also find out that if you control through the hydrocarbon, it is the more effective way of controlling the oxidant.

What you strive to achieve is a certain ratio between the hydrocarbon and the NO_x. This doesn't get down to the sticky problem of where you set the standard because that is considerably below that.

Senator BUCKLEY. In your statement, you state most air quality regions will be reclassified to remove requirements for an NO_x control strategy.

What impact would this have on the attainment of the other ambient air standards? Would it enable industry to move more rapidly toward the control of others?

Mr. RUCKELSHAUS. I think that is the same question you asked before. I think in general, Senator, it is easier to control carbon monoxide and hydrocarbon in the automobile if the NO_x standard is relaxed.

We have systems which are durable and seem to work very well in controlling HC and CO.

There is very little CO from stationary sources. The control of NO_x and CO from stationary sources I am informed is unrelated. So there will not be, with the exception of the oxidant standard, which will be easier to control to the extent you could control hydrocarbons more easily from the automobile, a relationship with the relaxation of the NO_x standard that would not affect our ability to control the other standards or the other pollutants.

Senator BUCKLEY. Mr. Chairman, are we still under the 10-minute rule?

Senator MUSKIE. I think so.

Senator Randolph.

Senator RANDOLPH. Thank you, Mr. Chairman.

The Evening Star and The News carried a lead editorial yesterday called "Air and Autos."

Mr. CHAIRMAN. I am in almost complete agreement. I feel this is a well-reasoned editorial. I may reflect what is said here or it may reflect something that I may have said, but I want it to go in the record at this point, if I may.

Senator MUSKIE. Without objection.

[The editorial referred to follows:]

[From the Evening Star and the News, Apr. 16, 1973]

AIR AND AUTOS

In allowing auto-makers another year for compliance with antipollution standards set for 1975, William D. Ruckelshaus struck a good balance in the public interest. In other words, as head of the Environmental Protection Agency, he chose the lesser of evils. The question was whether to insist on meeting that year-after-next target at all cost, or to deviate from it sufficiently to avoid economic penalties that the nation might be hardpressed to pay. A sizable segment of the auto industry appeared certain to fall short of the '75 requirements, and plant shutdowns conceivably could have caused a good deal of unemployment had Ruckelshaus refused to relent.

The fear, of course, is that this may become a commonplace kind of decision that eventually will make a shambles of the Environmental Protection Act. And indeed, harder tests may lie ahead. Industry with heavy employment may keep trying to back the government down, simply by pleading inability to comply with standards, and trusting that its economic leverage will translate into political power. But Ruckelshaus seemed to affirm that this will not work henceforth in the matter of auto pollution control. The EPA is intent on full-scale application of the 1975 standards in 1976 car models—an option which Congress wrote into the clean-air law. This seems well within the manufacturers' capability, and in any case there should be no thought on the government's part of further concessions.

Unfortunately, that thought appears to be an obsession with the car-makers, who reportedly are planning a high-powered drive in Congress for relaxation of basic standards in the 1970 Clean Air Act. This is not, we think, a battle they can win—nor should they. The resources that would go into such a public relations and lobbying campaign instead should be applied to meeting the technological challenges of compliance. After all, the EPA ascertained that General Motors and Chrysler were fully able to meet the 1975 emission standards on most of their production for that year, though Chrysler lagged dismally. One more year is long enough. The car-makers, some of whom are suspect of having made too little effort, should be told it's all there is, and to make every day count.

In the meantime, Ruckelshaus has decided to squeeze out all the clean air he can for the public during the year's delay, by imposing strong interim emission standards. These would go halfway in 49 states toward the final limitations of hydrocarbons and carbon monoxide, and two-thirds of the way in smog-plagued California. And that, it seems to us, is a good and shrewd trade. It will allow a year for hard testing in California of the catalytic depolluter which most auto-makers are depending on, and also afford those of us elsewhere a good deal of relief from fumes. Beyond that, Ruckelshaus will ask Congress to ease the stiff nitrogen oxide emission standards set for 1976, which seems justifiable and would make the manufacturers' task much easier.

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Senator RANDOLPH. It comes to grips in a well-reasoned way, I think, Mr. Administrator, with the matters that are certainly under consideration by you at the present time. I think you have made two suggestions, Mr. Ruckelshaus. One I would say you have asked the Congress perhaps legislatively to provide you with authority to change the 1976 nitrogen oxide standards for autos.

That would be one; and that you perhaps using authority under the Clean Air Act can also eliminate all transportation controls and emission requirements for stationary sources intended to reduce nitrogen oxide emissions.

Am I correct in perhaps saying that you are thinking in the terms of the two-pronged approach?

Mr. RUCKELSHAUS. I think the first one is correct, Senator Randolph. I am not sure I understood the second request.

Senator RANDOLPH. You have authority now, do you not, authority under the act to eliminate transportation controls and emission requirements for stationary sources intended to reduce nitrogen oxide emissions? Am I wrong in that?

Mr. RUCKELSHAUS. No. We have the authority to reclassify regions which we have mentioned our intention to do and thereby obviate the need for stationary controls or transportation controls aimed at nitrogen oxides; yes.

Senator RANDOLPH. Then as your answer indicates nearly all stationary sources, including steam electric generating stations will be free from Federal controls on nitrogen oxides except where States may impose these on their own. Am I correct in that?

Mr. RUCKELSHAUS. I think that is right, with the exception of new source performance standards for which there are nitrogen oxide controls required.

Senator RANDOLPH. Will some controls not continue to be necessary in some of our very heavily populated areas to maintain acceptable ambient levels of nitrogen oxides as defined by the States? Will this not be required at least as far as they provide for controls beyond the point necessary for the portection of public health?

Mr. RUCKELSHAUS. I think clearly we need to maintain control in Los Angeles and Chicago, at least as we now have analyzed it. It could be that other cities would be added as our analysis goes forward. This is a requirement under the act that air quality, the state of implementation plans provide for maintenance of air quality levels which would require some controls. I think the correct answer to your question, Senator, is that this is the kind of analysis that we have to continue to go through in order to come up with a clear answer for you.

Senator RANDOLPH. I am in agreement with that response.

In the Clean Air Act there is authority, Mr. Ruckelshaus, whereby the State of California has the opportunity, to set more stringent auto standards than the Federal standards for nitrogen oxides. Is that correct?

Mr. RUCKELSHAUS. Yes. That is correct.

Senator RANDOLPH. Have you presented your findings to the State of California.

Mr. RUCKELSHAUS. Yes. When Mr. Maga, who testified at our hearing, was on the stand I asked him the direct question, whether he was aware of the analysis that we had done on our nitrogen oxide measurement technique. He said that he was. I asked him if he had any questions himself about this analysis. He said no, he thought it was correct.

Senator RANDOLPH. Do you feel California will support your findings?

Mr. RUCKELSHAUS. I think they continue to believe there is a necessity to have a lower emission of nitrogen oxide level in California in order to achieve acceptable levels of nitrogen oxides, particularly in the Los Angeles Basin, as is reflected in their request for a waiver which we have granted for 1974 and again for 1975 to set the level at 2.

Senator RANDOLPH. Let's say that the Federal auto standards for nitrogen oxides are revised. What do you feel about the State of California? Will it hold firm to the standards it has established if a Federal revision takes place?

Mr. RUCKELSHAUS. I don't know that any revision we are suggesting here as to the automotive emissions would have any effect on California's request to maintain levels of nitrogen oxide controlled from the automobiles. In fact, the indication we have from them is they believe the level of 2 as opposed to 3.1 nationwide of the nitrogen oxide standard was important for the State of California and they felt it was necessary in order to achieve acceptable levels.

Senator RANDOLPH. This leads me to a final question. I think it is an important one, Mr. Ruckelshaus. What about the California situation from the standpoint of the possibility that its auto standard becomes the auto standard for the Nation?

Mr. RUCKELSHAUS. The nationwide hydrocarbon and carbon monoxide standards, once the 1973 legislative mandated standards are met, are more stringent than California has recommended. The nitrogen oxide standard that California has recommended we believe at least at present is addressed to the peculiar problems that exist in California.

Senator RANDOLPH. Do you think there will be a pressure to adopt the California standards across the board, nationwide?

Mr. RUCKELSHAUS. There already is pressure. I think the chairman yesterday noted by inserting into the record an advertisement that has been taken out. However, the California standards as recommended by them back in 1969 were not related to health. They were related to what they felt could be technologically achieved. So the question of whether it is necessary to achieve the levels of reduction that Congress has set for CO and HC are health-related questions and not related to what can be technologically achieved. So as long as Congress sticks to its conviction which I think it should, that these standards should be very stringent in order to protect the public health, then the argument as to the adoption of the California standards is an entirely separate kind of approach to the problem.

Senator RANDOLPH. Mr. Chairman, you will recall that we bore down heavily on the health factor in the very beginning. It was important to do so. But in this case for nitrogen oxides the California standards are more stringent.

Mr. RUCKELSHAUS. Yes. That is correct.

Senator RANDOLPH. Therefore, although you say from the beginning it was a technological approach, it became, did it not, a health approach, also?

Mr. RUCKELSHAUS. Dr. Greenfield?

Senator RANDOLPH. Maybe not.

Dr. GREENFIELD. The information we have, Mr. Randolph, is that the California standard on NO_2 was predicated and originally put forward primarily on the basis of the visibility problem. The formation of oxides of nitrogen causes a brown cloud.

With the Chattanooga data, they have no other data other than what we have, they have tried to relate that standard to the health portion of it. But it is primarily a nonhealth standard as we have to face up to it at the Federal level. So while they hold onto that standard, whereas we feel we must base it on the health issue only, at the present time, we have to take the position that we are taking. It may very well be that as more data becomes available we will want to go back toward what the Californians now have or even more stringent, back toward the 90 percent. But we just don't know right now because of the health requirement.

Mr. RUCKELSHAUS. I think it is important to point out that California's present standard is considerably less stringent than the 1976 Clean Air Act standard, we are talking about a difference between 2 and 0.4. The present Federal standards, the 1973 Federal standard, is 3.1, which is lower than the uncontrolled or pre-1973 Federal nationwide automobile.

So we do have some Federal standard presently applying to automobiles and we are not at this point recommending that that standard be relaxed.

Senator RANDOLPH. Gentlemen, I think you will agree that enhancement of air quality is inherent in the provisions of the Clean Air Act. Isn't that true?

Mr. RUCKELSHAUS. That is certainly true.

Senator RANDOLPH. I think we must not overlook that fact as you move forward and as we move forward, Mr. Chairman, in the assessment of the continuing problems which we must face.

Thank you.

Senator MUSKIE. I wonder if I might ask one question, Senator Domenici, that I think might be useful in connection with Senator Randolph's question?

Senator DOMENICI. Surely.

Senator MUSKIE. Looking to your decision, the 42-page decision, I think it would be useful to put some numbers into the record as to what we are talking about when we talk about controlling nitrogen oxide, the emissions from cars.

With respect to uncontrolled cars, the emission I believe are 3½ grams per mile. Is that correct? This is from page 4 of your decision.

Mr. RUCKELSHAUS. That number started to go up as the HC and CO started to go down. I think that is important.

Senator MUSKIE. I am trying to establish a point of reference.

Mr. RUCKELSHAUS. That is the correct figure.

Senator MUSKIE. An uncontrolled car emits nitrogen oxide at the rate of 3½ grams per mile. I assume that can vary from car to car?

Mr. RUCKELSHAUS. Yes.

Senator MUSKIE. Then the Federal 1974 standards are 3.1 grams per mile?

Mr. RUCKELSHAUS. That is right.

Senator MUSKIE. The California 1974 standards are 2 grams per mile?

Mr. RUCKELSHAUS. That is right.

Senator MUSKIE. The proposed California 1975 standards, that is the California proposal, is 1½ grams per mile? The statute, the Clean Air law, would reduce that to 0.4 gram per mile in 1976, if left unchanged?

Mr. RUCKELSHAUS. That is right.

Senator MUSKIE. I think it is helpful to put those numbers in the record at this point so we can all know what we are talking about and I may have some followup questions on it. I don't want to interrupt Senator Domenici. He may want to get into it himself. So I yield to him at this point.

Senator DOMENICI. Thank you, Mr. Chairman.

Mr. RUCKELSHAUS. Mr. Allen made a point that is important at this point. That is, if we didn't have a Federal NO_x standard of 3.1 it is our best estimate that in the effort to control HC and CO we would likely see the NO_x go up to between 4 and 6.

Senator MUSKIE. I see. That is an important number, too.

Senator DOMENICI. Let me first, Mr. Chairman, ask of the scientist team, constant referral is made to the Chattanooga experiment and in arriving at the health standard, it is basically still our best scientifically provable case, not on possibilities, but at least on scientific probabilities. Is that correct?

Dr. GREENFIELD. It is the most complete set of data at the present time.

Dr. FINKLEA. This complete set of data dealing with human health, we have a more complete data from animal experimentation.

Senator DOMENICI. And the source of NO was basically not automobile emissions?

Dr. GREENFIELD. Not NO, NO_2. It was the Volunteer Army Arsenal, a dynamite factory.

Senator DOMENICI. You have told us that you are having a great deal of difficulty measuring, coming up with a real, reliable measuring mechanism that you can use around the country at various stages to arrive at content with real reliability. Is that correct?

Dr. GREENFIELD. It takes time to test these things out and determine all of the collection efficiencies and what inhibits the reliability of instrument. Once you know that which has been calibrated accurately, then the instrumentation is there for you to use. If it is a difference between the Federal standard that we did have, which has the problem of collection efficiency, and the three other techniques that are coming along very nicely and will in a fairly short time, within the year, probably, give us a new, more accurate Federal method.

Senator DOMENICI. The Administrator is asking for, as I understand it, authority to set instead of the fixed 90 percent, Mr. Ruckelshaus, you are asking for the authority to set some other percentage control on automobile emissions. That is the one point you conclude with, that you think you must change the fixed one and give yourself some flexibility. Is that correct?

Mr. RUCKELSHAUS. That is correct, Senator.

Senator DOMENICI. Do your present studies indicate you are going to have to have a given percentage cleanup requirement for different parts of the country?

Mr. RUCKELSHAUS. Only in California do our present studies indicate that for the automobile we may need lower emission levels in order to achieve the health-related standard where the standard presently is.

Senator DOMENICI. Are we saying that the difference may be dictated by other contributing components to the air? What if you have an area where the NO_2 is coming from another source? What are we going to do about that? Wouldn't you need to clean them both up?

Mr. RUCKELSHAUS. Yes, clearly. There are stationary sources of NO_2 as there are mobile sources of NO_2. Where we are in a priority one region, where there is a violation of the primary standard, there is a necessity to adopt a control strategy over both stationary and mobile sources that will achieve the ambient air quality standard. What we have shown in the charts that Dr. Greenfield just went over, that based on our present measurement techniques instead of 1974 regions needing this control strategy, there are only two.

Senator DOMENICI. Then as you look at the automobile emission control part of this function of your agency, you are suggesting that we relax the 1976 standard as to this particular component? Is that correct?

Mr. RUCKELSHAUS. Yes. I am suggesting that the standard as it was set by the Congress based on our analysis now no longer seems justified. That is why I am suggesting we ought to publish this analysis and give people a chance to comment on it.

Senator DOMENICI. It is already admitted that complying with the standard by virtue of catalytic mechanism is indeed a difficult part of the automobile industries coming up with control of emissions, is it not?

Mr. RUCKELSHAUS. The technology involved in achieving HC and CO levels and nitrogen oxide levels works against each other to a certain extent. So it is difficult to control both or all three.

Senator DOMENICI. So whereas you have added some rather objective kinds of rules for the automobile industry, yesterday when you spoke of relaxing this one, we have made it rather vague as to when they are going to have something precise from you and does not this require some significant leadtime and if that is so, when do you expect to come up with your precise recommendation in lieu of the 90 percent?

Mr. RUCKELSHAUS. I think that there are a number of things we have to bear in mind. One is what should we do in the time period between now and when the research effort that was outlined on the board is completed and we can have a more firm idea as to what precisely needs to be done in order to protect the public health.

I see no reason to retreat from the present methods of control that have been imposed on automobile emissions. But the remaining question is how much more stringent should we make them? Once we come up with the analysis probably in the next 18 months is the basis on which this ouline was made which would indicate a firmer idea of where that standard ought to be than we would have to set that standard at that level that would be protective to the public health and at that point the automotive industry would have to meet it.

Senator DOMENICI. You say you don't see any reason to relax it. Then, do we assume you will set it as 90 or higher if we give you that authority?

Mr. RUCKELSHAUS. No. I am saying I don't see any reason to relax the standard where it is now; not where it will be in 1976 because if you are going to achieve a standard by 1976 given the HC and CO requirements that are also going to be necessary in that time frame, they need to know now or shortly what they have to shoot for technologically in order to continue the momentum to achieve that standard.

Senator DOMENICI. So what is your best notion of what it is going to be for 1976 if you set it with reference to the nitrogen cleanup part?

Mr. RUCKELSHAUS. The Congress could agree with what I am saying and decide there was no reason to retreat from where we now are and leave the standard there statutorily just as you have done in setting the 90 percent reduction standard, if that is of concern to the Congress.

Senator DOMENICI. That isn't the question. What if we do agree with your suggested amendment which you say you are going to ask the committee to consider giving you the authority? I am asking you, do you have enough information now to say whether you would set it at 90?

Mr. RUCKELSHAUS. No. I can't set it at 90. What I am saying is what we ought to do in my judgment is leave it where it is now and we get continued control over nitrogen oxide. It is not as though nitrogen oxide is going to start going back up. On the contrary, it will continue now, just not as steep a curve as otherwise. Until we get this analysis completed, the research completed from which we can make a firmer projection, I can't tell you at this time where that number ought to be.

Senator DOMENICI. So the auto industry, if this is what we conclude, will have the leadtime because they do know what will be expected of them. Is that correct?

Mr. RUCKELSHAUS. Yes. I think the kind of leadtime consideration would be the same thing the Congress took into account when it set the standard to begin with.

Senator DOMENICI. I have no further questions at this time. Thank you.

Senator MUSKIE. To make that clear, your recommendation would not mean that the nitrogen oxide emissions would be uncontrolled?

Mr. RUCKELSHAUS. No. It would not be that.

Senator MUSKIE. If additional controls were not applied, that would mean for the time being until you set new standards that the standard for nitrogen oxide would level off at, say, 3.1?

Mr. RUCKELSHAUS. Yes; Mr. Chairman.

Senator MUSKIE. Until we act again or until you act again on the authority we give you, what you mean by continuing present controls is setting the standard at 3.1?

Mr. RUCKELSHAUS. That is right. Yes. I, by no means, can give you a solid reason why that is what we ought to do. I think what we are suggesting to the committee is the necessity of looking very carefully at this 90-percent-reduction standard that is in the law and coming up with what should be done in the meantime until we get a better idea of where it ought to be.

What I have suggested here is that the setting of the standard be in effect given to the administrator of this Agency. If the Congress felt there was a necessity to maintain a certain level of control while this analysis was going on, again, I think that is somewhat of an open question.

Senator MUSKIE. I think what troubles the committee and it seems to me obviously troubles Senator Domenici, is that we must be clear about what it is that is being proposed, that we may in fact be encouraging the industry to relay its concern about NO_x emissions, relax and, on the record, it requires very little encouragement to relax its drive toward technological breakthroughs and, indeed, it may settle into a technological rut focused on HC and carbon monoxide in a way that would make it even more difficult later to focus on the NO_x problem at such point as policy becomes crystallized.

Have I made my concern clear?

Mr. RUCKELSHAUS. Yes. I understand your concern. I think that what we have to do in order to develop a sound public policy is in addition to being very firm on the desirability and need to meet the —— and —— standard, that where new evidences or new developments occur that indicate there may not be any benefit, public benefit, to achieving a given level of pollution reduction, that we be very careful in determining what levels of reduction we necessitate if it turns out 4 or 5 years from now we have caused enormous societal expenditure and it is the consumer who is going to end up paying for this, without any benefit to him.

That is what we are trying to do, is to be sure that what we are requiring is in fact going to result in a health benefit and environmental benefit to the country.

Senator MUSKIE. If we should adopt the policy you are recommending which would mean relaxing the 90 percent cutback on NO_x for 1976, is it conceivable that after having done that, when we had the benefit of the research, the results of the research program that your associates have described this morning, is it conceivable that the public interest may require reimposition of the 90 percent cutback for 1977, 1978 or 1979 or 1980?

Dr. GREENFIELD. Maybe I can answer it this way, Senator. We are, in addition to the research we are doing on trying to determine what the number should be in terms of ambient air quality standards, we are also trying to look very hard at what this means in terms of the auto emissions standards. You have got to look at both, obviously. If I ask myself from the analysis made, what is the range of possible values right now that bracket where our knowledge currently stands, and sort of give a worse case analysis, in terms of the annual arithmetic means, it might run somewhere between 94 micrograms per cubic meter, up to maybe 188. That is about the range of annual value that you might say might be important.

Or in the short term issue, it might range between 200 micrograms per cubic meter up to 376. That is the shorter term, 10 percent value. If I now ask, say, in the Los Angeles area, where you have probably the worse problem, what does this mean using one of the rollback analyses, in terms of the number of grams per mile that you have to reduce the automotive emissions to, it ranges from 3.2 at the upper end, at the more optimistic end, down toward the order of 1.1 gram per mile at the lower end.

So you see that within the range of uncertainty we currently have, with the type of analytical techniques we have available to us today, using a worse case analysis, starting where we currently are, 3.1, we might indeed in the long run want to push it down to the order of 1, maybe even closer to .4. We just don't know right now. We have got to wait until we have that number to allow us to set it in a more intelligent manner.

Senator MUSKIE. How long will it be before we get that number?

Mr. RUCKELSHAUS. 18 to 24 months is our current estimates, based on the research activities we laid out for you.

Senator MUSKIE. If you were to advise the automobile industry, which has an elastic standard as to the amount of leadtime it requires to meet the requirements of public policy, as to how much attention they ought to give the nitrogen oxide problem as they plan their hardware for the next 5 years, what would you advise them to focus on, the lower end of that range or on the higher end of that range?

Dr. GREENFIELD. If I can draw on the experience we have seen in the other health rehabilitated standards, almost every one of the standards that have been set as we get more research seems to push it harder and harder, push it into more stringent needs. The NO_x standard may be in exactly the same position. As we get more information, as we see what the multitude of problems really are, as we move down toward the cardiovascular problem, we may indeed want a more stringent standard. If I was going to visit the automotive industry, I certainly would advise them to move toward the lower end rather than the upper end. I think prudent would demand that.

Senator MUSKIE. On the question of Senator Randolph, you focused on another aspect of this problem, that is, it is visibility. It is what produces so much of the unpretty aspects of the Los Angeles air basin.

I assume the California standards are related to this question. At what levels is it necessary to set NO_x standards to eliminate that esthetic concern?

Dr. GREENFIELD. Of course, they are claiming 1.5 as the value they get to, which is within that range we are talking about as well, 3.1 down to 1.

Senator MUSKIE. Let me read you something from part 3 of our hearings of 1972. This is from Mr. James M. Pitts, Jr., Statewide Air Pollution Research Center of the University of California at Riverside. He had something to say about the NO_x standard. He said:

> The EPA auto emission standard for 1976 of four grams per mile of NO_x took into account, or at least attempted to, the total air burden and included emissions from powerplants. This is a major reason for their very strict auto emission standards. The value of one and a half grams per mile of NO_x for 1976, in my opinion, is simply not strict enough when one considers the additional NO_x that will be produced because of the energy demands that are being made by the residents of our air basin and the critical shortage of gaseous fuels for powerplants. When liquid fuels are burned, the NO_x burden in the atmosphere will go up by at least a factor of two and this is not taking into account the growth in power needs.
>
> In short, I regard a motor vehicle emission standard of .4 grams per mile of NO_x in 1976 as being absolutely essential in the South Coast Air Basin, in the New York area, and in most every major urban area with a serious smog problem.

What he says there, ties the auto emission standard very closely, of course, to the stationary sources. I wonder if you would want to comment on that?

Dr. GREENFIELD. I think what Dr. Pitts is saying is probably very true in the south coast basin area where the automotive pollution plays such a large role. It is not at all clear that this is not also true in places like New York, Chicago, and other areas where the auto doesn't play that large a role.

Senator MUSKIE. I raise this testimony because of Mr. Ruckelshaus' suggestion earlier this morning that these policy recommendations be included in the Federal Register for comment. Unless Dr. Pitts is persuaded by the kind of presentation you have made to us, we are going to get adverse comments upon your recommendations.

Dr. GREENFIELD. Dr. Pitts remarks were also made before we noted the problem with the measurement and reclassified those areas.

Senator MUSKIE. I understand. But I say unless he was persuaded by the Presentation you made this morning and your position doesn't change, then we are going to hear a lot about this. So I am simply putting this before you this morning so we can begin to get the dialog started and the issue drawn for the purpose of enabling you to make your case in the face of possibly contrary opinion.

Mr. GREENFIELD. That is exactly why, Senator, that at the administrators insistence we are going to put this analysis in the Federal Register and invite public comment to give us and the others a chance to examine the validity of the analysis that we have made and the implications of it.

Senator MUSKIE. What is the nature of NO_x control in today's technology and in the technology that will be applied for the purpose of dealing with other pollutions? Is it just an incidental control, incidental to the catalyst that would be installed on the automobile to control HC and carbon monoxide? What is the nature of NO_x control in the present technology?

Mr. RUCKELSHAUS. The primary control in the automotive emission is an exhaust recirculation valve which in effect recirculates exhaust gases for further reduction in nitrogen oxide. So that there is a specific control mechanism being used on the present automobiles for control of NO_x.

Senator MUSKIE. It will be continued?

Mr. RUCKELSHAUS. Yes. Again, it doesn't seem to me to make sense to go back and start all over again, particularly in light of the HC and CO increased reductions that would push the NO_x up if there were no controls.

Senator MUSKIE. Will the hardware you have just described eliminate that possibility?

Mr. RUCKELSHAUS. Either that hardware or some other. If we leave the standard where it is, we have to continue to control it at that level. If they can find a better way to do it, we would encourage that.

Senator MUSKIE. Do you have any indication of the extent to which the NO_x problem will be aggravated as the control on hydrocarbons and carbon monoxide are tightened? To what extent is that a technological problem?

Mr. RUCKELSHAUS. It is a problem clearly of controlling two, HC and CO at the same time. As you tightened the controls on both of them, it becomes more difficult to do that.

Senator MUSKIE. The hydrocarbons standard for 1973–74 I gather is 3.4 parts, grams per mile and the 1976 law will require reducing that to 0.41. Carbon monoxide is at 39 grams per mile and it will have to be reduced to 3.4. That suggests that the pressure, upward pressure on NO_x, will be considerable. Did the companies present testimony to you that they are going to effectively continue that upward pressure to hold NO_x emissions at 3.1 if your policy recommendations on NO_x is adopted?

Mr. RUCKELSHAUS. I don't have any testimony from the companies to that effect, Mr. Chairman.

Senator MUSKIE. You have not made that proposal?

Mr. RUCKELSHAUS. No. I never proposed to them that we do this. I have made the proposal several times in the hopes that if Dr. Pitts or whoever thought this proposal was ridiculous would say so. What I am suggesting today is that we get this out in the public now and let the dialog start.

Senator MUSKIE. The reason I raised this question is I was sure that would be your answer because the issue was not raised in the hearing, that we now pose a different technological problem or issue for them and we need a response. It is conceivable, for example, that in order to meet a NO_x problem of that dimension that they would still have to consider the other catalysts?

Mr. RUCKELSHAUS. Our technology assessment that is in the decision itself and in the appendix assumes that they would meet a 3.1 NO_x standard for 1975 without the catalyst, without any production catalyst. In fact, our technical people think that they can go down to 1.5 without the use of the additional catalyst.

Senator MUSKIE. If they can do that, shouldn't they be required to in light of the other implications of the NO_x pollutants or studies and so on?

Mr. RUCKELSHAUS. I think that is certainly a legitimate question for the committee to consider. With the increased exhaust gas recirculation need, there is presently a substantial fuel penalty in the neighborhood of 15 percent to get down to 1.5.

Senator MUSKIE. I think my time is up. Senator Buckley has been very patient.

Senator BUCKLEY. Thank you, Mr. Chairman.

Mr. Ruckelshaus, the testimony this morning indicates, I gather, that even if there is a reduction in the NO_x emission standards, we would still have at least two areas in the country where the ambient NO_x would be above the levels mandated.

Mr. RUCKELSHAUS. There are two areas of the country where they violate the 100 micrograms.

Senator BUCKLEY. The requirement as to ambient standards in accordance with the present law?

Mr. RUCKELSHAUS. Yes.

Senator BUCKLEY. You, of course, had the miserable duty of having to propose a Draconian approach to meeting the standard in the Los Angeles basin. This brings to mind two statements you made yesterday which greatly interested me. One was your statement that you felt there was a need for greater flexibility in handling the LA type of situations. You also stated that as research continues to find that smaller and smaller quantities of pollutants in the air will have adverse health effects. Does this suggest or would you suggest that among the options this committee needs to consider is that of moving away from a policy of zero health risk standards for the entire population?

In other words, ought we to consider as an option the setting of standards which will eliminate the health risk to, say, 99 percent of the population while requiring that areas like Los Angeles be surrounded by signs saying, "Beyond this point breathing may be injurious to your health"?

Mr. RUCKELSHAUS. I think, let me say as far as Los Angeles is concerned, Senator Buckley, that what we want to do in Los Angeles is run out the string on attempting to come up with a most reasonable plan that we can devise that will achieve the standard in Los Angeles by 1975 or 1977. What is it we can do? We are in the process of attempting to do that now. To assess the possibility of setting milestones, assuming that the plan itself appears to be unworkable, setting milestones along the way as to what they might do to achieve the standard ultimately. That is the kind of presentation we would like to make to the committee before we would make any recommendations as to what that flexibility ought to be if in fact we need additional flexibility.

The other question that you raise which is certainly fundamental is supposing in a case like Los Angeles, if you couple the zero health risk standard with the very tight time frame in which the standards must be achieved, and the achievement of the standard itself within that time frame, while there is no question but what it benefits the air, might put such a disruptive force on the community that you have all kinds of effects that when weighed against the improvement in the air seem to be more important to the community.

For instance, if it were necessary, as we now assess, to remove up to 80 percent of the vehicles or reduce by 80 percent the vehicle miles traveled at certain periods in the summer in Los Angeles, what would be the health effects of that?

There clearly are some health effects. If it affected a person's ability to get to the job, make enough money to buy food, feed his family, it is going to have a health effect on that individual.

We can't weigh that at the present, under the present law, against what we are attempting to do. So you can get at it in one of two ways. You can permit something to be weighed against a zero health risk standard or against the necessity of protecting the public health with one standard or you can give additional flexibility in moving the time-out in which a health related standard can be achieved.

As Dr. Greenfield and Dr. Finklea will undoubtedly tell you, as we get more data on the various pollutants, it is clear that it tends to drive the standard down because we find health effects at ever lower level of these pollutants and it does appear that for some pollutants there simply is no threshold above which there is no health effect. So it gets to the point of eliminating all of that pollutant from the discharge in order to satisfy a zero health risk standard.

How do you deal with this problem? It is an extremely difficult problem to deal with from the point of view of how you set a standard short of a zero health risk in what things are permitted to be weighed against it. I think historically, as I view the committee's decision to set a zero health risk standard, it was based on the fact that against health in the past was weighed the phrase economic feasibility. The concept of economic feasibility has been often greatly abused in the past in that it was an excuse for doing nothing.

Having been in the State agency back in the early 1960's, I was faced constantly in attempting to get compliance with the pollution standard with that phrase in the statutes. "It is too expensive, can't do it, it is not worth it. Therefore, we are not going to." In general the courts would agree with that position.

The question is because the concept of economic feasibility was abused, does that mean to discard it or is there some way to avoid the abuses that occurred in the past? I think that is something the committee ought to consider. It is a very difficult problem to wrestle with.

If I had any suggestions as to how you might resolve it, I would be glad to give them to you.

Senator BUCKLEY. I was going to suggest, as you are in the difficult position of having to try to plan strategies, we think about the alternatives perhaps it could be helpful if you would define for us, if you can, the areas of flexibility which you feel would enable us to achieve public policy.

Mr. RUCKELSHAUS. Yes. I would be happy to do that, Senator.

Senator BUCKLEY. Thank you.

There is one other question I would like to ask. It refers to the question I asked yesterday and again this morning. There seems to be a conflict between conclusions drawn by the EPA study and by the National Academy of Sciences as to fuel economy. I refer to this because I happen to be very much engaged in doing something about the fuel crisis. But I believe you stated yesterday that it was the EPA conclusion that the 1975 model year requirements did not have significant adverse fuel impact.

Mr. RUCKELSHAUS. Over 1973.

Senator BUCKLEY. The National Academy of Sciences states on page 4 of its study, and referring to the 1973 model year light-duty motor vehicles, it concludes that model year 1975 vehicles using Wankel engines or catalyst equipped spark ignition piston engines will use significantly more fuel than their 1973 counterparts.

Mr. RUCKELSHAUS. The Wankel may be based on the fuel penalty associated with the Mazda rotary engine. Where they arrived at the conclusion that the catalyst equipped 1975 automobile would have a significant fuel penalty, I don't know. The basis for my answering your question yesterday was testimony at the hearings by the major automotive companies, where in fact General Motors said they thought they would get about the same fuel economy from their 1975 system as they do from their 1973 vehicles.

The catalyst itself does not cause any significant fuel penalty that we have been able to discern. There was testimony by Ford and Chrysler of some minimal fuel penalty problems. But again, in response to questioning, a lot of that was answerable on the basis of the advanced engine modification they might be using or in the case of Ford, I believe it was, the lower NO_x standard which they were thinking about.

So on balance, it was our best assessment that it would not be any significant fuel penalty associated with meeting the 1975 standards with the catalyst equipped automobile.

Senator BUCKLEY. I am not questioning your conclusion. I am again disturbed that the public record would seem to have this conflict in the conclusion. I was wondering perhaps if somebody in your agency could consult with the appropriate person that participated in the study?

Mr. RUCKELSHAUS. I certainly will. I don't understand how they conclude that. We will be glad to see any analysis they have and submit it for the record of this hearing.

Senator BUCKLEY. Thank you very much.

I have no further question, Mr. Chairman.

Senator MUSKIE. I am sure all of us would like to pursue this health question and the NO_x question further. But at this point this morning we had agreed informally to give you an opportunity to make another presentation that we think is important to an understanding of this whole subject; that is, the impact of the emission controls and the cost effectiveness of alternatives.

I know you have developed such a presentation. I think it would be very useful to the committee and a very important part of the record, and I suspect of interest to the public. If you are ready to present that at this time, I think maybe we should receive it and maybe tomorrow we could get into any other questions on health and NO_x matters as the committee may desire.

Mr. RUCKELSHAUS. Mr. Chairman, that is fine. We did have available today both Dr. Finklea and Dr. Greenfield in the event the committee felt there was any necessity to go into the CO and HC health related standard.

Senator MUSKIE. I would like to do that. Would they be available again tomorrow?

Mr. RUCKELSHAUS. Yes.

Senator MUSKIE. I would like to get this other basic presentation today so that tomorrow we can get into whatever questions remain in any area of this subject including this one.

Mr. RUCKELSHAUS. Mr. Sansom?

STATEMENTS OF ROBERT SANSOM, ASSISTANT ADMINISTRATOR FOR AIR AND WATER PROGRAMS, AND GEORGE V. ALLEN, JR., DEPUTY ASSISTANT ADMINISTRATOR FOR ENFORCEMENT, ENVIRONMENTAL PROTECTION AGENCY

Mr. SANSOM. Mr. Chairman, I don't have formal charts. I think there are about 100 copies in the room. Assuming everyone has a copy of the handout, what I want to review here very briefly is an analysis of the relationship between the emissions standard for the automobile and the number of air quality control regions that would meet the primary standards for the automotive related pollutants without transportation controls.

The first chart which you have is a chart that summarizes the present air quality in terms of the number of air quality control regions for carbon monoxide and oxidants that are in violation of the primary standard.

You can see that 29 of those are in violation of the CO standard and our best estimate based upon the State implementation plans is 26 of those 29 will be requiring transportation controls in 1975. For oxidants, the total of 54 in violation of standard, 30 of which would require transportation controls in 1975.

To give you some appreciation for the magnitude of the problem, the number of people in cars involved, we see that these totals, the 30 and the 26, because some of the same regions are in violation and require transportation controls for the achievement of both the oxidant standards and carbon monoxide, it comes down to a total of 38 air quality control regions out of the 247 in the country that require some degree of transportation and the land use controls in 1975.

CHART NO. 1

PRIORITY I—AIR QUALITY CONTROL REGIONS

Carbon Monoxide—Total Number: 29
Requiring Transportation Controls: 26 [1]
Oxidant—Total Number: 54
Requiring Transportation Controls: 30 [1]

Mr. SANSOM. These air quality control regions represent 91 million people or 43 percent of the total population and about 42 percent of the total automobile population.

We have provided in the past a list of the air quality control regions involved, a listing is provided in that second page.

CHART NO. 2

SCOPE OF TRANSPORTATION/LAND USE CONTROL PROGRAM

38 AQCRs require additional transportation/land use controls and/or two year extensions to meet standards.

These AQCRs represent:

A. Approximately 91 million people or 43% of the total population

B. 41 million of the country's 98 million motor vehicles (42%)

C. Majority of the major cities of the country, i.e., Los Angeles, New York, Chicago, Denver, Boston, San Francisco, Philadelphia, Dallas, etc.

The third chart goes to the question of the type of control of the automobile, a series of alternatives here, ranging from alternative one, which is a continuation of the 1973–74 Federal emission standards, and those standards are listed. In other words, if we didn't do anything beyond what we are doing now, and the second option is the set of standards that the Administrator has imposed on all of the States except California for 1975. This is a set of standards achievable at advanced engine mods.

Mr. SANSOM. The third option of the 1975 standards, the 90 percent reduction standards, which will be achieved nationwide in 1976, with the exception of the NO_x standard which is the present NO_x standard. The 1976 standard is now 0.4 which the Administrator could extend for 1 year.

Lastly, is the 1976 standard for HC and CO, the same as 1975, but with the 90 percent reduction for NO_x?

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[1] Designation of AQCR's requiring transportation/land use and/or 2 year extensions is based on Federal Register Notices dated May 31, 1972; July 27, 1972; Sept. 22, 1972; and Oct. 28, 1972.

CHART NO. 3

ALTERNATIVE CONTROL STRATEGIES

I. Continuation of 1973/74 Federal Emission Standards:
30 gpm CO; 2.8 gpm HC; 3.1 gpm NO_x
II. Controls achieveable by Advanced Engine Modifications
15 gpm CO; 1.5 gpm HC; 3.7 gpm NO_x
III. 1975 Standards as achieved by Oxidation Catalyst with replacement
3.4 gpm CO; .41 gpm HC; 3.1 gpm NO_x
IV. 1976 Standards achieved with Questor System in 1976 and later models
3.4 gpm CO; .41 gpm HC; .4 gpm NO_x

Mr. SANSOM. The next chart summarizes the fact that these varying degrees of control on the 26 air quality control regions that require transportation controls in 1975. From that chart you can see that if you stuck with the 1973–1974 standards that even in 1985, 21 of the 26 air quality control regions would still need transportation controls if they were to meet the primary standards.

As an increased stringency of control, the engine mod strategy, which is, you can see the number of air quality control regions needing transportation controls in 1985 drops by six. If you go further, there is an additional 12 drop as a result of the achievement of the 1975 standards, the 90 percent reduction standards for carbon monoxide.

You can see the effect of increasing stringency of controls is very small in the early years. That is because of the time it takes the automobile population to turn over at those higher degrees of control.

CHART NO. 4

EFFECT OF VEHICLE CONTROL STRATEGIES ON 26 REGIONS REQUIRING TRANSPORTATION CONTROLS FOR CARBON MONOXIDE

NUMBER OF PRIORITY I AQCR'S EXCEEDING STANDARDS[1]

	1977	1980	1985	1990	Standard never achieved
I. Continuation of 1973-74 standards	24	21	21	22	21
II. 1975 standards based on advanced engine models	24	18	15	18	15
III. 1975 standards with oxidation catalyst[2]	20	16	3	7	3

[1] Implementation of required transportation controls and/or stationary source controls is not assumed.
[2] Implementation of 1976 standards yields similar results.

The next chart is the oxidant chart. The same analysis and again you see, and in this case, there are 30 air quality control regions in 1975 that require transportation controls and you can see if you continue with the 1973–1974 standards, 17 of those will still require transportation controls in 1985 and you can see with increasing to the engine mod levels of control that 13 would still require transportation controls, while 17 would not, and then as you go further, into the 1975 HC standard, only 10 out of the 30 would require transportation controls in 1985. Twenty would not.

Let me qualify this in a couple of ways. Even in the case of those air quality control regions requiring transportation controls with these varying degrees of control, the stringency of the control would be less as you have the increased degree of control, if you will follow me.

In other words, the 10 regions requiring transportation controls would have an increasing stringency of control as you increased up to the chart. This is a crude measure of the number in violation. But it does not reflect the increasing stringency control.

CHART NO. 5

EFFECT OF VEHICLE CONTROL STRATEGIES ON 30 REGIONS REQUIRING TRANSPORTATION CONTROLS FOR OXIDANT

NUMBER OF PRIORITY I AQCR'S EXCEEDING STANDARDS [1]

	1977	1980	1985	1990	Standard never achieved
I. Continuation of 1973-74 standards	.26	19	17	22	17
II. 1975 standard based on advanced engine mods	24	17	13	15	13
III. 1975 standard with oxidation catalyst [2]	22	13	10	12	10

[1] Results do not assume the implementation of required transportation controls and or stationary source controls.
[2] Implementation of 1976 standards yields similar results.

Mr. SANSOM. The next chart really is redundant to the discussion we just had, but summarizes that we had 47 air quality control regions classified in violation of the primary standard using the Jacobs-Hockheiser technique and as a result of arsenite bubbler method, that the number in violation goes down to 2.

The point there being the relative number of air quality control regions as opposed to the large numbers involved in the case of hydrocarbon and carbon monoxide, a very small number now involved in the case of NO_x.

CHART NO. 6

NO_2 AQCR Reclassification

Current Classification

Jacobs-Hochheiser Reference Method
47 AQCR's Classified Priority I

Potential Reclassification

Arsenite bubbler method
2 Priority I AQCR's: [1] Los Angeles (185 ug/m^3), Chicago (120 ug/m^3)

Mr. SANSOM. The next chart is a summary of the cost data, for the achievement of these standards, using the best cost analysis that we could do. You can see that the sticker price impact, operations and maintenance impact and the total 11-year cost impact, 1975 to 1985 for the country.

CHART NO. 7

COMPARATIVE COSTS OF CONTROL SYSTEMS

[Base 1973-74]

	Sticker price	Annual O. & M.	1975-85 total national cost (billions)
Engine modification	$100	$-5	$11
1975 oxidation catalyst system	185	[1] 10	41
1976 questor system [2]	205	42	71

[1] Assumes 1 catalyst replacement
[2] The questor system has consistently met 1976 standards at low mileage but at a substantial fuel penalty

[1] Lower bound of Priority I is 110 ug/m^3

Mr. SANSOM. The chart is self-explanatory. The minute 5 in the O. & M. for engine mods is a result of the high energy ignition system that our technical people say will be employed and that would cut down the number of times you have to change your sparkplugs and points. That is a small saving.

As you can see, the initial cost goes up with the catalyst, and we use $85 as a catalyst cost. The catalyst car would have essentially all the engine mods on it that the engine mod standard car would have.

I think that the column to the right summarizes, you can do the subtraction and incremental cost, $30 billion to reach the 1975 standards over the engine mod cost, and another $20 billion to reach the 1976 standard over this 11-year period assuming that the Questor System is employed to meet that standard. We would be the first to recognize there are a lot of uncertainties about these costs and that they could go down.

We have found in the past as you get closer to the technology that the costs tend to go up a little and stabilize, then what you expect with the learning curve and so on that the costs would go down.

These are our best estimates. They could be subject to change.

Senator MUSKIE. That third column, national cost, that includes fuel penalty, doesn't it?

Mr. SANSOM. Yes, sir. That does.

Senator MUSKIE. Could you break that down into fuel penalty costs as against other costs?

Mr. SANSOM. We could break it down. I don't have those figures here. We are assuming for the 1976 Questor System a 12-percent fuel penalty. The other two do not have a fuel penalty associated with them. The other two options, the engine mod, modification option, and the 1976 catalyst option do not have the fuel penalty associated with them. Only in the case of the Questor System is there a 12-percent penalty.

I did not mention the things that people think are involved in our engine modification package, quick heat manifold, high energy ignition, improved carburetor, proportionate EGR and air injection are the things that we have included.

The next chart is a chart which I think should be used with caution, but nonetheless is worthy of some consideration. That is, we tried to look at the cost of achieving these standards, the 1975 standards, in this case with two other alternative technologies that have received some attention in the hearings.

Cost of alternative engine technologies (base 1973–74)

	(Billions)
Honda precombustion system [1]	—$ 12
Diesel precombustion system [2]	—106

[1] Honda is presently working to scale up the size of its engine. When this is accomplished we can better identify the potential cost reductions of such a system.

[2] EPA is studying the emissioins characteristics of the diesel (odor, particulate, HC, CO and NO_x) as well as the problems of refinery conversion and noise.

Both technologies presently meet 1975 HC and CO standards with NO_x less than 1.5 gpm.

Mr. SANSOM. Here the Honda prechamber system, we have the $12 billion savings over the current costs that are now being borne with the 1973–74 system. The reason for this is a 12 percent fuel economy benefit that would accrue as a result of the use of this technology.

Senator MUSKIE. Does that mean it is $53 billion cheaper than the catalyst system?

Mr. SANSOM. That is right. Likewise, in the case of the diesel, you can see, because the diesel gets better fuel economy than the conventional car, you would have a very dramatic overall cost savings to the Nation, but this should be caveated in the double asterisk there which provides the caveat, in that we in EPA still have several reservations about the emissions from the diesel. We are studying these. By the end of the year we should have a complete assessment.

At the hearings, the Mercedes contended that the noise problem had been solved. We really haven't confirmed that. Their view was it had been solved by changing the size of the combustion chamber. We are also concerned about particulate emissions and odor emissions from the diesel.

The next chart summarizes what we have been here in terms of the number of air quality regions, meeting transportation controls under the engine modification option, versus the oxidation catalyst option. You can see that by going from engine modifications to the catalyst with regard to carbon monoxide, you take 12 air quality control regions out of the requirement for transportation controls in 1985 and you can see with regard to oxidants you take three out of the requirement, but of course even those remaining in would have a much lesser degree of stringency required in the transportation controls.

You can see the incremental cost of going from the present standards to those standards in the botton line, which is just repeated from earlier charts.

CHART NO. 9

COMPARISON OF STANDARDS ATTAINABLE WITH ENGINE MODIFICATIONS AND OXIDATION CATALYST

	Engine modifications	Oxidation catalyst
1. Number of AQCR's exceeding CO standard in 1985	15	3
2. Number of AQCR's exceeding oxidant standard in 1985	13	10
3. Cost of system over 1975 85 (billions)	$11	$41

Mr. SANSOM. In order to try to get some perspective on the cost incurred, what these numbers mean, we have listed on the last page the cost, incremental cost over 1973–74 systems of the engine modification options and the 1973 standards option and the option of meeting the 1976 standards and compared that with some consumer conveniences that are purchased at the consumer's option today.

CHART NO. 10

RELATIVE CONSUMER EXPENDITURES

	Sticker price	Annual O. & M.	1975-1985 national cost (billion)
Engine modifications	$100	$5	$11
1975 standards	185	10	41
1975/76 standards	205	42	71
Vinyl roofs (46 percent)	92		7
Radio (80 percent)	59		8
Air conditioning (69 percent)	350	36	65

Note: Other power options include: Automatic transmission (90 percent); power windows (15 percent); power seats (13 percent); and radio (80 percent).

Mr. Sansom. I think you can see with regard to an air conditioner, we are in the same ball park, almost, as costly as the 1976 standards and certainly more costly than the achievement of the 1975 standards.

I think the other numbers there just give you some idea of what the consumer is paying for other things relative to this cost.

Senator Muskie. I think one point I would like to focus on. In the 1950's the diesel was available as a technology for passenger cars. In the mid-50's the stratified charge engine, which is today the Honda option for the consumer, was technology. And neither of those have been chosen by the industry.

The public could have been saved, according to your figures, $53 billion in the case of the Honda, and almost $150 billion in the case of the diesel. That is a pretty expensive option which the American automobile companies have chosen in our name as consumers of American automobiles.

As I understand your decision, Mr. Ruckelshaus, an important factor in your decision and in pushing the industry into the catalyst option was the question of leadtime.

That is in order to meet 1975–76 standards it is your judgment that the industry didn't have the time to move into alternate engine systems and that the only practical option left to you was the catalyst.

So clearly the question of leadtime is critical to any reevaluation of the requirements of the Clean Air Act. For example, should Congress determine that the auto industry needs to be forced to another solution to the problem, we would need much better information on leadtime.

There are two approaches, it seems to me, to answering that question. First of all, there is the Japanese situation. In October 1972, the Japanese adopted what they euphemistically called the Muskie law. It differs from the Federal Clean Air Act only in the test which is used and the standards are in grams per kilometer. The Japanese promulgated their regulations implementing the Muskie law on an interesting date, December 7, 1972.

The Japanese have announced that they do not intend to give their domestic industry the additional year which Mr. Ruckelshaus has proposed for their American counterparts.

In other words, the Japanese intend to comply with the Clean Air standards in 1975 in Japan, 34 years after Pearl Harbor.

The question I would like to put is how are the Japanese able to do this with their full range of cars for 1975 if American manufacturers are not?

The second question under the subject is relative to Honda. Honda was able to develop a new engine which it intends to market in 1975 in the United States. How is Honda able to turn around its production in this short period of time if the American companies are not?

Mr. RUCKELSHAUS. Let me answer your first question first, Mr. Chairman. It is our understanding of the Japanese law that at the present time their test procedure, as you mentioned it is significantly different than ours and we would have to analyze their test procedure to see what correlation there was between where we have set the standard and where they have set their standard.

For instance, they don't have a test procedure now. They simply proposed one. It is our understanding that the weight that they have given to the cold start is considerably different than what we had which would have a significant impact on where that correlation of numbers would occur.

Second, their standards doesn't really take effect until a year later. It doesn't take effect until October 1975, which is when our 1976 standard would take effect. So that our standard is still in effect for 1976, which is essentially the same time theirs is.

So I think you have to be a little careful in looking at what the government has said in Japan as to what they are doing and see how it relates to what we are doing.

The question as to the Honda, as to why they had leadtime, Mr. Allen may be able to respond, but they have taken a long time in developing this engine.

Mr. ALLEN. As I remember, Mr. Chairman, from the testimony of Honda, they seemed to me to be very cautious in the pace at which they have developed and introduced this new system. They are going to introduce it in 1974 in Japan on a fraction of their Japanese sales.

In 1975, they will introduce it in the United States on a fraction of their U.S. sales.

This kind of limited sale of over 2 years is a much slower pace of introduction than we are requiring in the case of catalysts. It amounts to what I understood to be a rather conservative program of introduction.

Senator MUSKIE. Let me ask you this: Does the Honda, or does it not, meet the 1975 American standards?

Mr. ALLEN. Every car we have tested has met our standards.

Senator MUSKIE. Did I not understand from your testimony yesterday, Mr. Ruckelshaus, that—I forget the numbers—but there will be a substantial sale of Honda cars in California meeting the 1975 standards which are proposed for California?

Mr. RUCKELSHAUS. It is my recollection of the testimony that they intend to sell 250,000 of these cars in Japan in 1975 and 250,000 in the United States.

Senator MUSKIE. Which met the 1975 standards?

Mr. RUCKELSHAUS. Yes; any car they sold here would have to meet the 1975 or even the statutory standards. I don't know if the car they are going to sell in 1975 in the United States will in fact meet the statutory standards or will meet the interim standards.

Senator MUSKIE. Notwithstanding the differences in their test procedures for meeting the requirements of their law, then the Honda is going to meet the requirements of our law?

Mr. RUCKELSHAUS. Yes, that is right. The Nissan Motors, there was another one, Datsun, testified that they could not achieve our standards, that they had somewhat the same problems that we do domestically with disagreement as to the availability of technology.

Senator MUSKIE. When did Honda start developing this clean engine, so-called, for the purpose of meeting the 1975 American standards and the requirements of Japanese law?

When did they begin to shift into this production line?

Mr. ALLEN. As I understand it, we knew a year ago, approximately a year ago, at the time we held our first hearing on this matter there was no testimony, however, by anyone in the stratified charge area.

The only developments we had known about involved the Ford Army tank command contract, for a stratified charge engine, which had to use a catalyst to meet the 1975 standards.

As I understand it, the precombustion, stratified, charged type of technology has been around for a very long time.

Everybody has been looking at it. No one had made the kind of breakthrough that Honda has suddenly made until they told us about it very recently.

We don't know exactly when they realized that they had a way of operating this engine that could meet these low emission standards without a catalyst.

Senator MUSKIE. Are they committed to the production model now?

Mr. ALLEN. As I understand it, they are already committed to producing cars using this technology in 1974, which given our understanding of automotive leadtime, means they are well on the way toward purchasing the necessary machine tools and so forth to produce the engine.

Senator MUSKIE. We don't have hard figures on exactly how much leadtime that represents from the point of beginning to the 1974 marketing of the car?

Mr. ALLEN. No. They were pessimistic, as I remember, that it would be possible for another company to produce very many of these engines in 1975. They were somewhat less pessimistic about the ability of other companies to change their production equipment over to producing significant number of these engines in 1976.

But Honda, which by no means is optimistic as compared to other automobile manufacturers as regard to leadtime considerations, they are about as conservative as the others in terms of their judgment as to how long it takes to change over to new technology.

Senator MUSKIE. On the basis of your impressions, they appear to have done it themselves in the range of 2 to 3 years.

Mr. SANSOM. Yes, sir, but it is my understanding that this technology requires an overhead cam engine. In other words, they have those engines already in their smaller cars. I think the only General Motors car with this type of engine is the Vega.

So it is easier to phase it into an overhead cam engine than it is to change the whole engine block and the machine tooling related thereto.

Senator MUSKIE. Did you get any testimony at all on this in your hearings?

Mr. ALLEN. Yes; we got quite a bit of it. I just don't remember it. I haven't read it recently.

Mr. SANSOM. In the case of the diesel and in the case of the stratified charge we asked how long it would take the major manufacturers in this country to get that technology into a significant number of lines of their cars. They said 1977 would be the first year they could have the large number of lines using this technology.

Senator MUSKIE. There is this interesting colloquy from the transcript of your hearing with Honda in which you put this question:

> My question is would you have the capability to produce those components in the Vega that you changed if General Motors wanted to buy these components from you for the Vega? Would that be possible for you?
>
> Answer. We think we can.
>
> Mr. STORK. In what volume could you produce the components that you must change by the 1975 model year?
>
> Answer. I do not have sufficient data to reply to your question, but we understand that the annual production of the Vega is about 400,000 and we think we can meet that much demand.
>
> Mr. STORK. Therefore, I assume it would be a reasonable statement to say that if General Motors either decided now to buy those components from you or decided to get a license from you and build them themselves, that is a technologically and logistically feasible undertaking for the Vega. Is that a correct assumption?
>
> Answer. By 1975?
>
> Mr. STORK. Yes.
>
> Answer. We don't have any inside information on General Motors but on the basis of our theories we see no reason why they cannot but this is all a matter of General Motors Corp.

Mr. RUCKELSHAUS. I think there are two things here. I was there when that dialog took place. I think as far as the retrofitting on the Vega was concerned, the Honda people were optimistic about their ability to provide the requisite parts to do that, that does not, of course, mean that General Motors would be able to meet the basic demand on their other automobiles with this technology by 1975.

My view continues to be that the best way to get all of this technology tested is by pushing that standard up to where it could be achieved and then letting the marketplace dictate how fast they will phase it in.

Senator MUSKIE. I raise these questions in part to illuminate your decision, but more for the purpose of trying to get some impression in the record of what leadtimes we are talking about.

This has been a constant difficulty with American automobile manufacturers.

The yardstick is a very elastic one, depending upon the purpose of the question and the policy to be served. In light of the fact that they are in full possession of the information that bears upon their own capabilities, the only resource of the committee is to try to get some insight from the experience of their Japanese competitors who I hope will be giving them a lot of competition on this particular problem in the next 1 or 2 years.

Did you want to respond further to that? I want to ask a question about the diesel in order to put the full issue before us.

Mr. SANSOM. Let me say two things. We had tested and supported with the Army the stratified charger developments in this country, or some of them.

In the case of the cars, we were supporting a catalyst as required in addition to the technology employed on these cars to meet the 1975 standards.

The automobile manufacturers did raise in the hearings and I don't think we have reached any technical judgment as to this statement, but that they were concerned about the ability to scale up the Honda-type technology to meet the 1976 standard.

It wouldn't make much sense to go through and completely modify the production line to meet the 1975 standard and then in the next year have to meet the 1976 standard with a different technology. That was another reservation.

Senator MUSKIE. Let me ask you what seems a rather obvious question. You have dismissed the idea with your decision of forcing the automobile companies to meet the 1975 standards for the whole country, across all lines. That is the decision.

But if it is possible for one of these companies to meet the standards for one product line in 1975, for the purpose of beginning to build a learning curve, or get some experience from it, why shouldn't they build it for Vega in 1975 if Honda could and if that particular automobile is convertible to the Honda-type engine?

Why shouldn't they?

Mr. RUCKELSHAUS. I see no reason why they shouldn't. I wasn't under the statute authorized to force them to do so. I think by putting the standards where we have it may well have that effect, particularly if in their judgment the Honda engine offers a sufficient threat to their more conventional internal combustion engine in the marketplace.

Senator MUSKIE. Wouldn't it be a good gesture on the part of General Motors to offer to the American people something instead of this constant negative attitude that we get. Why wouldn't it be a good idea for them to say to the American people, "We are not required now to meet the 1975 standards in the light of this decision, but the Vega conceivably could be adapted to the 1975 standards.

"So we commit ourselves to do our best to produce a Vega with a Honda-type engine for 1975 as evidence of our good faith and determination to meet this challenge."

Wouldn't that be an excellent posture for them to take?

Mr. RUCKELSHAUS. I think it would be.

Senator MUSKIE. Wouldn't it make you feel better about their willingness to meet your policy requirements?

Mr. RUCKELSHAUS. It would make me ecstatic, Mr. Chairman.

Senator MUSKIE. I would like to ask about the diesel.

General Motors mass produces an Opel diesel in Europe. It would be interesting to find out, I think, when General Motors introduced the Opel diesel. I think it was 1972, and when the decision was made by General Motors to introduce the Opel diesel. If that decision was made subsequent to the enactment of the Clean Air Act or the White House meeting of 1969, then it appears that GM could have made a similar decision for domestic production, but the only reason they failed to do so was because of competitive problems.

In 1970, when we were working on the Clean Air Act the industry did indicate that their absolute minimum leadtime was 2 years from the date on which the specific standards were set and they had determined the technology to achieve those standards was available.

If we assume, one, that the diesel or stratified charge engine meets the standards; and two, that existing engine manufacturing facilities can manufacture major components of either the diesel or the stratified charge, then if notice is given today to go to an alternative engine, it would be reasonable to assume that the industry could be in production in 1976 without significant disruption.

What difficulties do you see with that observation?

Mr. RUCKELSHAUS. Mr. Chairman, I think that we did delve into this question of leadtime at some length in the hearings. We asked the tooling industry how long it would take to shift their present production of the conventional internal combustion engine over to something like the diesel which is also an internal combustion engine and probe in many other areas what time it would take.

The tooling industry was very pessimistic in their apraisal of how long it would take. I think their testimony was in the neighborhood of 12 years. That testimony was denied by most of the major automotive companies who said it wouldn't take that long.

Our best estimate as to how long it would take to put in an entirely new technology across all lines of automobiles sold domestically, some 11 million of them, is in the range of 5 to 10 years.

If 2 years is one of the assumptions in your question, I think 2 years would be if they had done a lot of the tooling and scaling up necessary to be able to mass produce and sell those cars, starting 2 years from when they had accomplished those initial requirements.

So that it is a very complicated question and the whole idea of how long it takes to get moving, I think a lot, to a certain extent, does depend on attitude, just how fast do you want to do it, what are the advantages to the company in doing it in this fast, quick period of time?

I think as far as our agency is concerned, as far as I am concerned, I am not prepared at this point to say which technology we ought to be pushing because we do have these questions about the diesel.

If we were to push the diesel today and a year from now we come up here with a similar kind of presentation on NO_x saying we should have thought of this, I would hate to have that happen.

I don't know that that would happen. But by the same token, there could be something about the stratified charge that we think a year from how may not be so good.

In my opinion, the best thing to do is to try to push all of these technologies as rapidly as we can, keeping in mind the potential for social disruptions that might result if the push got over to where they weren't able to cope with it.

Where that line is it is very difficult to draw. I am certainly not, I don't know if anybody is capable of saying where it is. But I do think that we should not underestimate the impact of the Clean Air Act's amendments since 1971.

I think we have pushed a lot of technology very fast in historical terms in a very short period of time. Whether this meets the optimum of what they could do, if all the motivation were there, I think it is another question.

Senator MUSKIE. That clean Vega in 1975 would reassure a lot of us. Senator Buckley, I apologize for trespassing on your time.

Senator BUCKLEY. Not at all.

A couple of questions.

First of all, if I could direct this question to Mr. Sansom, about his chart No. 7, which is the chart in which you compute the national cost of the various systems. I believe the economists call this internalizing costs.

Do you have any way of quantifying how much of those respective costs would be represented by a transfer of externalized costs—health, nylon stockings, and so on?

Mr. SANSOM. No; in other words, you are asking on the benefit side what would be the decrease in the number of nylon stockings that would have to be purchased and so on. No, we do not. In the paper, we just have very great difficulty coming up with benefit numbers on the automotive pollution, and in our cost of clean air document that we submitted to Congress last year we have been very cautious saying we just do not know.

It is hard to translate these damage functions, in this case it is health damage, because we don't have welfare standards for these pollutants, although there might be welfare benefits to achieving the health standards, it is very difficult to translate these into national benefit efforts for the control of these pollutants.

Senator BUCKLEY. I know guesstimates are dangerous. But in your educated opinion, does any substantial proportion of this represent a national standard?

Mr. SANSOM. Yes. I think it does. But I could not say what proportion.

Senator BUCKLEY. More than half?

Mr. SANSOM. I just could not say.

Senator BUCKLEY. I do think that an understanding that what we spend on the one side involves savings on another side is important to the public weighing of these decisions.

In another area you spoke about the Honda engine, which has been scaled up so it could be useful in a Vega.

Is my understanding correct that Honda has also scaled up their engine to V-8 size?

Mr. SANSOM. That is right. We have heard that they put it on two Impalas.

Mr. RUCKELSHAUS. They told us at the hearings they were doing that. Since that time there has been a press release from Honda that they have successfully done that. I don't know that we have checked out that claim as yet.

Senator BUCKLEY. I assume you will seek the opportunity to test it?

Mr. RUCKELSHAUS. Yes, we will. The earlier claims by Honda several months ago of their ability to achieve the standards with this stratified charge engine was met with some skepticism on the part of domestic companies. In fact, I read where one of them believed this was only applicable to the one cylinder engine. Then it was later applicable to even more cylinders. Then we finally got all eight of them involved.

Senator BUCKLEY. A member of my staff advised me she has driven an Opel diesel located in this country and says in her expert opinion it is a splendid car except for acceleration.

I just mention this because I wonder if it does not illustrate some of the factors that you have found in coming up with your own decisions.

Presumably, we could either through law or regulation so sculpt the process as to force a given manufacturer to actually produce a diesel.

I am not sure we could force the consumer to buy it if in fact its performance is inferior to other comparably priced cars, at least until such time as fuel is a lot more expensive than it is today.

Mr. RUCKELSHAUS. I think the performance is one of the assumptions the domestic companies make in indicating an unwillingness to market the diesel in this country.

The Mercedes people testified that while their diesel had a good deal of acceptance in some European countries, particularly where the gasoline price was very high, that they did not feel it has the same degree of acceptance here. Although I am not satisfied in my own mind that some of that doesn't have to do with advertising techniques and just what kind of acceptability is built into the American public's mind by what they are told through advertising they ought to buy.

Senator BUCKLEY. I suppose it might also relate to the scarcity of diesel pumps in different areas.

Mr. RUCKELSHAUS. It might, although I think you can get diesel fuel with some imagination on the part of the driver.

Senator BUCKLEY. With that extra effort.

If we were to move in the direction of trying to encourage the utilization of the Honda-type engine or a diesel, are there certain of the major manufacturers that would just not be capable of putting them on stream as soon as others? In other words, wouldn't we be forcing an uneven production on the part of the automobile industry as it exists today?

Mr. RUCKELSHAUS. It would depend on the amount of leadtime involved. If you provided sufficient leadtime you could obviate that problem. Obviously, if you made it very short, you probably would give an advantage to one manufacturer over another. It is my opinion, in fact, that what we are doing is encouraging a very strong look at the Honda system and the diesel system by our decision.

Senator BUCKLEY. We will wait to see on that one in the marketplace.

Mr. Chairman, I have no further questions.

Senator MUSKIE. Senator Domenici?

Senator DOMENICI. Just a couple, Mr. Chairman.

Mr. Ruckelshaus, I understand you announced heretofore at a press conference that you would soon promulgate the regulations for diesels. When will these regulations be ready?

Mr. SANSOM. I think what to promulgate is a new test procedure for diesel. I think it is about 6 months is the date on when that will be out.

Mr. RUCKELSHAUS. The emission standard is the same. It is the test procedure that is different.

Senator DOMENICI. Let me share with you a concern of the group of scientists that looked at the present status of things for me in New

Mexico. They would say with reference to the leadtime and the thrust that we are now imposing on the industry to get on with new technology, that the controls are forcing new technologies with reference to cleaning up the emissions. The scientific group that gave me a report says they have another concern that is very serious. That concern is that they don't see any real thrust toward economizing energy that we as an institution, or in Congress, are forcing on industry. They have no immediate suggestion, but they have a very serious concern. But they don't see any of that in what we are doing at this point, that we seem to have our eyes rather firmly fixed on cleaning up emissions and we are going to force this great industry in America to move in that direction.

The suggestion is we should all together be looking at what can we do to force some energy savings, even if it is not directed at the same thing right now.

Do you have any observation, the economists or you on that concern?

Mr. RUCKELSHAUS. That is in general true. It is clear that we are pushing toward cleaner emissions as a society from the automobile to achieve a given social benefit, healthy air. In this thrust, at least in the systems that are being adopted for the achievement of these standards by the domestic companies, we are causing some fuel penalties.

So to that extent we are not as concerned with fuel consumption and the emission devices impact on the consumption as maybe we ought to be.

On the other hand, I think these two problems are not necessarily related, that if as a society we decide that it is important enough to conserve fuel because it is in short supply or the cost is going to be going up or for whatever reason we say that is important and therefore we are going to impose regulations to do that, then I think that should be viewed separately from the problem of emissions because there are a number of things related to the present day automobile and its use and its relationship to mass transit, for instance, that cause a very inefficient use of energy.

Even in the automobile itself, where you have a comparable fuel penalty with the automatic transmission and the air conditioner with emission control system, the enormous gap is between a 2,000- and 5,000-pound car of 150 percent fuel penalty, all of those things it seems to me should be looked at first because there is no particular social benefit except convenience associated with the use of those devices on the automobile as opposed to the emission device for which we are saving one man's right to use his automobile is not to be exercised at the expense of another man's right to breathe healthy air which seems to me is a social purpose that overrides the conveniences associated with some of the other things that cause a fuel penalty.

Senator DOMENICI. I think the concern that they express is legitimate and you would say, you have agreed here that it is a legitimate concern? You would just say they are not necessarily to be sought after at the same time? They may not be?

Mr. RUCKELSHAUS. Yes; I have sort of a personal resentment at delaying the whole energy crisis at the fee of the emission devices in the automobile when there are so many other things that cause fuel penalties that we are not paying any attention to.

Mr. SANSOM. Plus the fact some of these technologies that could achieve the standard could have a very substantial fuel savings associated with them.

Senator DOMENICI. One further comment that this same group gave to me with reference to the engines that meet standards without catalytic mechanisms. They state you tested three engines that met the 50,000-mile durabiliy requirement for the emission standards. The Honda meets the requirement through the vortex combustion, with a small engine displacement, provides 65-horsepower which limits its use to 1,600-pound automobiles. The Mazda rotary engine which meets the standards is small and also requires a thermoreactor for oxidation of carbon monoxide and unburned hydrocarbons, even these engines will require additional development to be suitable for standardized and larger cars. The Mercedes diesel is a fairly large engine, they say, but it emits fumes also and is noisy. Both characteristics are objectionable but not covered by current standards.

In summary, have they taken the heart of your tests on engines that meet the Federal standards?

Mr. RUCKELSHAUS. Yes; except I think we have been over some of these problems before with the other technology, except it does appear now that Honda has been able to go on beyond the small automobile that its engine was associated with. If their recent statements are correct, they have adapted their system to larger engines which might be used on larger automobiles.

Senator DOMENICI. I have no further questions, Mr. Chairman.

Senator MUSKIE. I have simply one observation on the question of leadtime. I have before me the technical appendix, appendix B to your decision, and on page—we have discovered a new numbering technique here—on page 00055, I don't know whether that is just an exclamation, but anyway, there is this paragraph that bears upon our earlier discussion:

> GM's position that alternative technology is not available to allow achievement of the 1975 standards is somewhat puzzling, considering the fact that a GM-owned company, Opel, is currently mass producing a diesel-powered automobile which has been tested by EPA and has achieved emission levels below the Federal 1975 requirements with less than 1½ grams per mile of NO_x. Stratified charge engines are also being studied by GM.
>
> The level of effort on these engines is, however, rather low.

With that last sentence, may I say that we will meet again tomorrow at 10 a.m. and two areas that we want to touch upon definitely are: (1) the health questions bearing upon EC and carbon monoxide; and (2) the good faith question which we haven't really gotten into, and then we will try to find enough time to touch on all of the wrapup questions the committee may have in mind.

Thank you very much.

[Whereupon, at 12:25 p.m., the hearing was recessed, to reconvene at 10 a.m., Wednesday, April 18, 1973.]

[illegible]

DECISION OF THE ADMINISTRATOR OF THE ENVIRONMENTAL PROTECTION AGENCY REGARDING SUSPENSION OF THE 1975 AUTO EMISSION STANDARDS

WEDNESDAY, APRIL 18, 1973

U.S. SENATE,
COMMITTEE ON PUBLIC WORKS,
SUBCOMMITTEE ON AIR AND WATER POLLUTION,
Washington, D.C.

The subcommittee met at 10 a.m., pursuant to recess, in room 4200, Dirksen Office Building, Hon. Edmund S. Muskie (chairman of the subcommittee) presiding.

Present: Senators Muskie, Randolph, Biden, Buckley, and Domenici.

Senator MUSKIE. The committee will be in order.

I understand that Mr. Ruckelshaus will be delayed 45 minutes this morning and that he will be with us a little later. In the meantime, we will take the opportunity to get into some of these emission-health questions in which we are interested.

We have with us this morning again Dr. Greenfield, Assistant Administrator for Research, and his associates.

Would you present them for the record, Dr. Greenfield, and then proceed? Do you have a formal presentation to make first?

STATEMENT OF HON. WILLIAM D. RUCKELSHAUS, ADMINISTRATOR, ENVIRONMENTAL PROTECTION AGENCY, ACCOMPANIED BY DR. STANLEY GREENFIELD, ASSISTANT ADMINISTRATOR FOR RESEARCH AND MONITORING; DR. JOHN FINKLEA, DIRECTOR, NATIONAL ENVIRONMENTAL RESEARCH CENTER; DR. DAVIS SHEARER, SURVEILLANCE DIVISION; GEORGE V. ALLEN, JR., DEPUTY ASSISTANT ADMINISTRATOR FOR GENERAL ENFORCEMENT; AND ERIC STORK, MOBILE SOURCES POLLUTION CONTROL PROGRAM

Dr. GREENFIELD. We might have a small statement to make just to clarify the paper to your staff. It describes the pyramidial approach in determining the adverse health effects. We might go through that.

Senator MUSKIE. Why don't you proceed and introduce your colleagues.

Dr. GREENFIELD. On my right once again is Dr. Finklea, who is Director of the National Environmental Research Center at Research Triangle Park, N.C. On his right is Dr. Davis Shearer, head of our Surveillance Division.

On my left is George Allen, from the Office of Enforcement and General Counsel. On his left is Mr. Eric Stork, from the Office of Air and Water Programs.

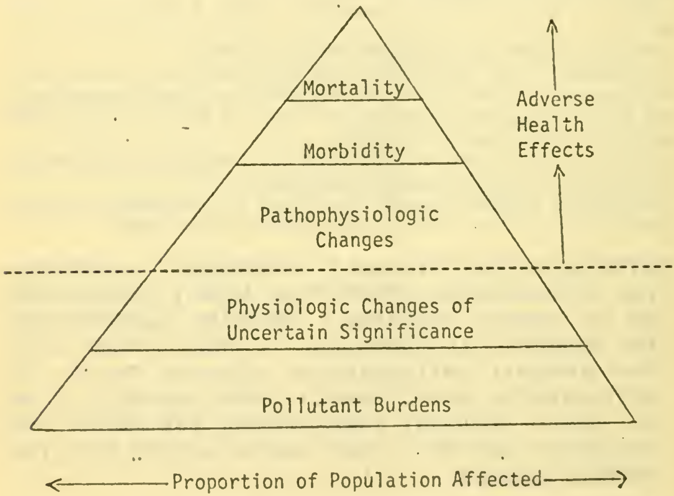
I will turn it over to Dr. Finklea at this point to go through a three-page document.

Dr. FINKLEA. Mr. Chairman, we have a three-page handout.

Beginning with the first one, we would like to consider what sort of adverse effects might be considered upon public health. We have a pyramid. The width of the pyramid represents the proportion of the population affected. The pyramid extends from death or mortality at the top, which affects a rather small portion of the population, down to a pollutant burdens. The legislation does stress our need to protect the public health and we run into a great deal of controversy as to what constitutes an adverse effect on public health.

FIGURE 1

SPECTRUM OF BIOLOGICAL RESPONSE TO POLLUTANT EXPOSURE



There is usually no disagreement that increased mortality, either the rate of daily mortality from usual causes, or an increase in deaths from a cause directly attributable to any pollutants, constitutes an adverse effect. Similarly, there is usually little doubt that an increase in the severity or frequency of a usual disease or of a disease that in itself can be attributed to a pollutant is an adverse effect.

Where we get into difficulty and get into discussion is whether or not a change in physiology or a change that you can examine under the microscope or biochemically in animal systems or in the humans, constitutes an adverse effect.

Within the agency, the scientists concerned with these matters feel that those changes in the way the body functions, which indicate an increased risk for disease or death, so-called pathophysiologic changes, are in themselves an adverse health effect. There are undoubtedly other changes which are of uncertain significance. These indicate that a pollutant has made the body function in a different way. But whether or not this different functioning is an adverse effect on health is often a very difficult problem to decide.

I think many of the controversies surrounding our present efforts to improve environmental quality are based upon the need to protect public health and involve this problem of defining an adverse health effect.

To illustrate this, perhaps we could move on to the second figure.

Senator MUSKIE. On the first chart, to try to put it in layman's terms, what you have said is any change in body functions which raises the risk of poor health effects is an adverse effect in terms of the policy that is now written into the law?

Dr. FINKLEA. No, sir. I said the law as written now defines a need to protect public health without a precise definition of what constitutes an adverse effect.

Senator MUSKIE. Would you try to summarize the two? The controversy revolves now around the two concepts you have just described. I want to be sure I understand those two concepts and the difference between them.

Senator RANDOLPH. Mr. Chairman, I must go to the floor. I will return later. But at this point could I ask one question?

Senator MUSKIE. Of course.

Senator RANDOLPH. I know that you realize that in the 1970 act we made provision, statutory provision, for the health effects from pollutants. You know that that is written into the basic law. As that research goes forward within the Environmental Protection Agency, I believe, Mr. Chairman, that until this time—and I suggest that it be done now—a status report has not been received specifically on what has been done by EPA in contrast with other groups in this area.

Are you using the National Institutes of Health?

Dr. GREENFIELD. Senator, we have prepared a preliminary document of that sort because under the law and under the policy of the agency we are constantly trying to update and get these criteria under which the standards are set. We have a preliminary document which looks at what underlies the standards up to this point and what new information has come about since the standards were set, and essentially where we stand today. We simply can make that available, if you so desire.

Senator RANDOLPH. Mr. Chairman, the reason I ask this is not in any wise to criticize what has been done.

I am sure you are carrying out the provisions of the act from the standpoint of your research, study and review. But I think it would be helpful to us to know exactly how this is being accomplished with the National Institutes of Health, with certain doctors within our own employ, and with certain outside expertise. I think it is very important that we not overlook the health effects from pollutants as provided for in the 1970 act.

I take this opportunity to bear down on this point because I think it is vital to our overall understanding of what happens on several fronts. This is one of those important fronts from the standpoint of the pollution of the air.

Dr. FINKLEA. Senator, we couldn't agree with you more. We feel that health effects are probably one of the key items in terms of environmental protection. It is evidenced in our whole research program. It constitutes a very large portion of our research money. In fact, we have devoted one of our main research centers to that subject, and that is evidence of it as well.

In addition, as you probably know, while the Environmental Protection Agency does not have all the environmental health effects funds in the Government under its purview, we must work and we do work very closely with the other agencies like NIH in attempting to satisfy our requirements.

Senator RANDOLPH. Thank you for your responses.

Thank you, Mr. Chairman.

Senator MUSKIE. Thank you, Senator Randolph.

Let me put my question again in terms of Figure 1.

Figure 1 is a pyramid with six layers in which you undertake to identify five broad areas of concern as we try to identify adverse health effects. The top layer is the smallest and involves mortality effects, which are clearly health effects.

Second, below that, are morbidity effects, which are clearly adverse health effects.

The third layer are pathophysiologic changes, which I gather you also identify as clearly adverse health effects.

It is the fourth layer which you are now discussing?

Dr. FINKLEA. Yes, sir. The distinction between the third and fourth layers——

Senator MUSKIE. Would you restate that distinction and try to do it in a way that a layman can understand what the distinction is?

Dr. FINKLEA. The third layer, the layer labeled "pathophysiologic changes," are changes in the way that the body functions which are clearly a risk factor for later disease.

Senator MUSKIE. You have no doubts about that layer at all?

Dr. FINKLEA. Correct, sir.

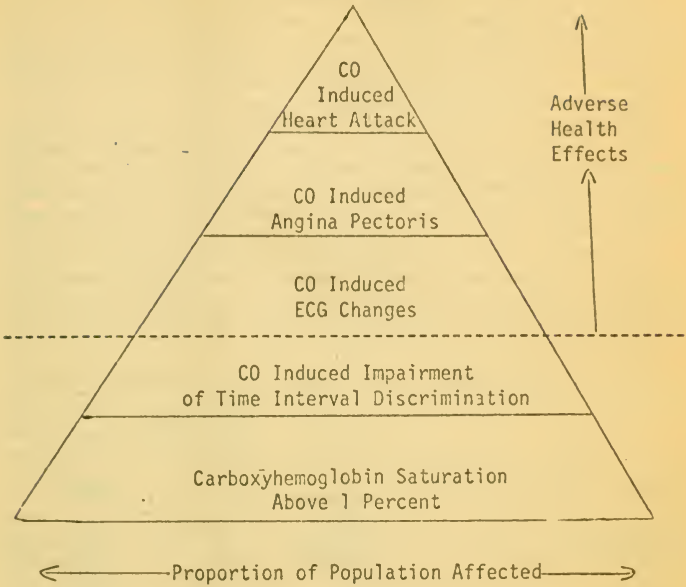
The layer below are changes in body functions whose significance is uncertain at the present time. We would not know whether these were perhaps of no consequence, perhaps even beneficial, or perhaps detrimental. So these are changes. They are effects that can be observed but their significance is unclear.

Senator MUSKIE. Now could you give us something illustrative?

Dr. FINKLEA. To turn to the second page and think about the layers of effects in relation to carbon monoxide, we can see that the apex of the pyramid that carbon monoxide induced heart attack, which would clearly be adverse effects. Such effects have been reported in studies from California where levels of ambient carbon monoxide is very high. They have not been observed in cities where ambient levels are about the present primary ambient air quality standard. It is unclear whether there is an effect of this sort, but I bring this to your attention as an illustrative problem, as a problem about which there is current controversy.

FIGURE 2

SPECTRUM OF RESPONSE
TO CARBON MONOXIDE



The next level, and once again dealing with people who have a compromised circulation to the heart, would deal with the induction or the bringing on of angina pectoris, or chest pain, in people who have compromised heart circulation. This has been demonstrated with carbon monoxide exposures which are sufficient to give carboxyhemoglobin levels of 3 to 5 percent.

You will recall the present ambient air quality standard would give us about a two-fold protection between the standard and the result shown.

We are also finding changes in the electrical activity of the heart after carbon monoxide exposure in people not known to have heart disease. These would be primarily males between 35 and 55 who would have abnormalities of the electrocardiogram after carbon monoxide exposures, again to levels which give you roughly 5 percent carboxyhemoglobin.

When we get to the effects of carbon monoxide on behavior or our performance, such as the time interval discrimination test, which was one test quoted in the previous criteria document, I think we get into an area in which there is a lot of discussion about whether or not this is clearly an adverse effect on public health.

Without judging whether each performance test is an adverse health effect, we can certainly say that there are adverse effects on human performance at the 5-percent carboxyhemoglobin level. When we get to the lower level, the changes in the carboxyhemoglobin itself, we can see in most urban areas there is some evidence of exposure to carbon monoxide among nonsmokers. I should qualify this entire discussion by saying that people who make a personal choice and smoke cigarettes have carboxyhemoglobin levels between 3 and 7 percent. Those of us who don't smoke and don't make this choice would normally be 1 percent carboxyhemoglobin or less.

I think this illustrates a range of problems that we run into with carbon monoxide. It illustrates our uncertainty in terms of the mortality. It does indicate the risk in terms of illness and in terms of risk factors for illness. It indicates that these are occurring at levels which are not far above those that we have in the primary ambient air quality standards.

In summary, from our information, since the preparation of the last criteria document, we would think that the primary ambient air quality standard is justified, that it provides a small margin of safety for the large groups in our population that suffer from diseases including the compromised circulation within the heart.

ADVERSE HEALTH EFFECTS WHICH MIGHT BE ATTRIBUTED TO PHOTOCHEMICAL OXIDANT EXPOSURES

Expected effect	Source of intelligence		
	Epidemiology	Clinical studies	Toxicology
Increased susceptibility to acute respiratory disease	No data	No data	Multiple studies.
Aggravation of asthma	1 semiquantitative study.	do	No data.
Aggravation of heart or lung disease	No data.	Isolated studies.	Do.
Irritation symptoms.	Multiple studies	do	High level exposures.
Altered lung function	1 negative study	do	Do.
Increased risk of chronic lung disease	1 negative study	No data.	Repeated suggestive results.
Cancer	do.	do	No data
Congenital defects	No data	do.	Suggestive evidence.
Impaired defense mechanisms.	do	do	Multiple studies.

Senator MUSKIE. Let me ask you a question with respect to the two charts, figures 1 and 2.

The dotted line slightly more than halfway from the apex of the pyramid represents the line above which you have no doubt that there are health effects?

Dr. FINKLEA. That is correct, sir.

Senator MUSKIE. That is true of both charts?

Dr. FINKLEA. Yes.

The committee had expressed a special interest in photochemical oxidant exposures. In the third table we have tried to summarize the present status of our knowledge in terms of what effects might be expected following photochemical oxidant exposures, and what sorts of research information we have available utilizing the population studies, clinical studies of volunteers and accidental exposures, and studies of experimental animals.

As you can see, there are a broad range of adverse effects upon health which involved increased frequency of some common diseases, such as respiratory diseases, through the aggravation of existing diseases, and to alterations of functions which may change their future disorders.

In addition, there are recent reports of an effect of oxidant exposure upon chromosomes in circulated blood. These chromosomes are affected by oxidants in a somewhat similar fashion to the effect of radiation. From the dose response data that these studies involve, it is our present opinion that the primary ambient air quality standard, which is just above natural levels in many locations, is adequate to protect the public health without an excessive margin of safety.

Senator MUSKIE. So that the standards that you have now applied, which you have confirmed this morning, do have a margin of safety but not excessive?

Dr. FINKLEA. That is correct, sir. It also should be pointed out that our data is far from complete. We, as you know, sir, have taken regulatory action based on the best information available. It may well be that as we accumulate more information, the margin of safety which is presently found in these standards will shrink.

Senator MUSKIE. In other words, the standards are not high enough or stringent enough?

Dr. FINKLEA. The standard may later appear not stringent enough; that is correct.

Dr. GREENFIELD. As a point of explanation, Mr. Chairman, the question of safety factor is the important one to understand. If you had total population studies so that you had a complete distribution of population from those that are not healthy to those that are very healthy, you could more adequately state what the safety factors should be. Where you are dealing primarily wih populations where you know they are susceptible to problems of this sort the feeling is that if you can protect this susceptible population then you are providing an adequate safety factor for the healthy portion of the population. So although you don't put a very large safety factor on the standards we currently have, they do carry with them the implied safety factor for the entire population.

Senator MUSKIE. I wonder if in that connection I might read to you a couple of paragraphs out of the report of this committee on the National Air Quality Standards Act of 1970, which seems to bear on that point.

> In requiring that national air quality ambient air standards be established at a level necessary to protect the health of persons, the committee recognizes that such standards will not necessarily provide the quality of air required to protect those individuals who are otherwise dependent upon a controlled internal environment, such as patients in intensive care units or newborn infants in nurseries. However, the committee emphasizes that included among those persons whose health should be protected by the ambient standard are particularly sensitive citizens, such as bronchial asthmatics or emphysematics, who, in the normal course of daily activity are exposed to the ambient environment.
>
> In establishing an ambient standard necessary to protect the health of these persons, reference should be made to a representative sample of persons comprising the sensitive group rather than to a single person in such a group. Ambient air quality is sufficient to protect the health of such persons whenever there is absence of an adverse effect on the health of a statistically related sample of persons in sensitive groups from exposure to the ambient air.
>
> An ambient air quality standard, therefore, should be the maximum permissible ambient air level of air pollution agent or class of such agents related to a period of time which will protect the health of any group of the population.

Senator MUSKIE. Is that sound policy?

Dr. GREENFIELD. That we feel is sound policy. That is essentially the way we have tried to carry out the study of these standards.

Senator MUSKIE. It is your view that the basic standards, on the basis of the evidence now available to you, are consistent with that policy?

Dr. GREENFIELD. Yes, sir.

Senator MUSKIE. Is there anything further in your presentation that you want to make?

Dr. GREENFIELD. No, Mr. Chairman. We are ready to answer any questions you or the committee wants to ask.

Senator MUSKIE. Since I have taken some time in questions, may I yield to Senator Domenici. I will come back.

Senator DOMENICI. Thank you, Mr. Chairman.

Let me ask a couple of questions with reference to the adequacy of coordinated research activities. It seems to me obvious that what you are telling us is that we are in the process of learning a lot more about our air standard requirements and adverse effects on our people, and that this is going to require a great deal of very delicate and truly scientific research on a continuing basis.

At one point in your testimony you said you controlled some of this and other research is controlled and handled elsewhere and you work together.

Might I ask, generally, are you satisfied with the level of research that is taking place to give you the kind of information that you need to tell us about our air and its components?

Mr. GREENFIELD. Are you referring to the level of research in our agency or to the Federal Government in general or the Nation?

Senator DOMENICI. Let's take your agency first.

Mr. GREENFIELD. I should preface this, and I don't mean in a flip way, with the statement that it is a very difficult question to ask any person in research whether he has adequate money because he never does, obviously.

Senator DOMENICI. I understand that.

Dr. GREENFIELD. But we have put together within the total budgetary requirements of our agency, both in research and all the other aspects of what we have to carry out, what I think is an adequate program to address the questions that we must address, both in air and water, and the other areas of the environment.

Obviously, you could always put a greater effort in, but you also must realize, as I am sure you do, that you don't just by increased results linearly with increased dollars that you lay on. Time is a function or a question, adequate personnel and trained people are a question also.

So, in carrying out a research program where you are faced with realistic or real world deadlines to provide the information within a legislative act, we lean on as much activity in other parts of the community as possible.

A good portion of our attempt is to work as closely as possible with groups in NIEHS and others as well. But we do have quite an intensive program both in-house and by contract and grant out of the Environmental Protection Agency, itself.

We have four national environmental research centers. These are major centers. One of the largest is the one at Research Triangle Park, and its major theme is environmental health effects. So a large portion of what it is doing is devoted to that subject.

Senator DOMENICI. With reference to ongoing research by other agencies completely unrelated to you that might have an effect on your research and important for us, and the effect of air quality on citizens of this country, is there a good coordination now? Is there a mechanism by virtue of which EPA has a significant input into acquiring their information and seeing that it is productive and coordinated and the like; or do you need more?

Dr. GREENFIELD. I think the major coordination mechanism is on a personal basis, the working level, primarily. For example, the National Institute for Environmental Health Sciences, is almost totally located in North Carolina along with Dr. Finklea's National Environmental Research Center. The head of that institute, Dr. Robb, works very closely, he and his people, with Dr. Finklea and his staff. That is the type of working relationship that we like to see going on all over the place. You have to realize that a good portion of what might be classified as environmental health effects research in the Federal Government is contained in groups like the Atomic Energy Commission, which is quite specifically pointed at the radiation effects, per se, as opposed to a broad spectrum of the environmental health effects.

From our standpoint, our closest working relationship is with the National Institute of Environmental Health Sciences and the broad spectrum of health research that exists in the country.

Dr. Finklea can add to that, if he wants to.

Senator DOMENICI. Would you please, Doctor?

Dr. FINKLEA. Being a little bit further away from the policy level and a little bit closer to the information request level, I think we are doing the very best we can with the resources which have been allocated for this job. Also, as a responsible Federal administrator, I realize that the Federal Government has many, many tasks. However, I join Dr. Greenfield in saying that I am quite sure that our efforts would be greatly benefited if additional resources were available. This is not to say that with all the jobs we have to do, we are not going to make progress in the next 2 to 5 years with the resources that have been allotted, because we are. However, the agency has the problem and the need for information which does change priorities from time to time.

For example, the progress that we would make in terms of oxides of nitrogen that we talked about yesterday will be purchased at the expense or at the cost of information from other fields dealing with air pollution. This is, I think, a realistic appraisal from the operating level.

Dr. GREENFIELD. Could I add just one thing, Senator? I think something very important should be stated.

Very often there is a considerable difference between what you might call the research time constant and the legal or political or what-have-you time constants, where you are trying to accomplish something of a public protective nature, such as what you have done with the Clean Air Act. This may not mesh entirely with how quickly you can get the information that allows you to do the best job possible.

So the research effort is constantly playing catch up, in a sense. You provide the best information you have available at the time to meet the deadlines that have been laid on you legally, but at the same time you are not completely satisfied with that information and you are driving your research program as hard as you can to improve and to fill in behind what you have done. As a result, this is the type of research program that has been designed as a result of this type of a problem.

Senator DOMENICI. One last question.

With reference to the same subject, do you know of any study in-house or otherwise that is inventorying the kinds of ongoing research that are relevant even if not being controlled by your agency, whether it is the Atomic Energy Commission or otherwise? Is there any study that puts it down on paper where a committee like ours could look at it?

Dr. GREENFIELD. We are extremely interested in knowing on a continuing basis what research is going on throughout the Federal Government in areas where we have an interest. We would like, basically, not to spend our dollars duplicating that but, more importantly, to be able to tie into it and acquire and use the information that they have and, if possible, to also provide some degree of suggestion or control, to see if they can emphasize some of the things that we think are more important. We are trying to look at how you set up the coordinating mechanisms right now.

Senator DOMENICI. But there is no such study reduced to a document that we could review?

Dr. GREENFIELD. There are two items that might be of use. One EPA recently put out in connection with the Smithsonian, information exchange on the total mix of environmental research that is going on in the country right now. That is never really up to date because it takes sometimes a year to get the information in. But, in addition, as Dr. Finklea just pointed out, there was a report put out within the last year or so by the Office of Science and Technology on environmental health, which tries to inventory what was going on to that point in the Federal Government. This is a document that has been released.

Senator DOMENICI. Thank you very much.

Senator MUSKIE. Senator Biden?

Senator BIDEN. Thank you.

Doctor, to get back to something that Senator Domenici was pursuing, initially, the question of adequate resources. I sense that neither of you feel you have adequate resources to do the job you have been commissioned to do in the time you would like to do it. Is that correct?

Dr. GREENFIELD. Once again, you have to be careful how you state it.

Senator BIDEN. You have to be careful?

Dr. GREENFIELD. That is right. No, I think we both have to because otherwise a certain amount of confusion occurs. You just cannot very often buy time with dollars. Just because you have a specific time limit or a deadline you are trying to meet, you don't automatically go toward it twice as fast by doubling the amount of money you have available.

What I was trying to say, and what I did say, I think, is that you never have, in the minds of the researcher, adequate money to do the job you would like to do. We have limitations in the budget available to EPA, limitations in the sense that we have a great many things that we have to do. You have to set priorities and lay them out according to some intelligent strategy.

Senator BIDEN. I understand that. That is not my question.

Dr. GREENFIELD. Within that budget and within those priorities environmental health effects has been very handsomely treated.

Senator BIDEN. Some of us wonder whether or not the entire budget is, in fact, large enough for your agency to do its job. Some of us, some of the newer people like me, wonder whether or not there is an intention to do the job as rapidly as it could be done.

Maybe I should direct my question to your colleague, who seems to be a little bit more inclined to be concerned about additional research dollars. I realize you can't say if you doubled the amount of money for research that we will cut the time in half in which to do the job. What I am asking you is: Do you feel that your research effort is in any way impeded by the lack of dollars and, if so, to what degree?

Dr. GREENFIELD. I can't answer the second part of that, because that requires some sort of quantitative answer and it varies depending on which area you are talking about. But, sure, the research is certainly impeded by lack of money. It always is, no matter where you are and what research you are doing. If you are going to ask the question whether the agency has enough money to do its total job, it is within that context that you have to address the adequacy of research funding, then I have to really turn to my superior who, fortunately, just came in.

Mr. RUCKELSHAUS. And I, of course, have to be guided by my science adviser, Dr. Greenfield.

Senator BIDEN. I am glad, Doctor, I don't have to run against you in Delaware. You handle questions very well.

I don't have any further questions, Mr. Chairman.

Senator MUSKIE. Senator Buckley?

Senator BUCKLEY. I would like to say that Senator Biden has just announced his plans to run again.

Doctor, as you know, the question of the health standards are referred to in various quarters. I will read one attack.

> Present studies show the carbon monoxide blood levels of nonsmokers in crowded cities across the country are already well below the 2-percent level that the EPA set as a goal for good health.

It goes on to cite figures for Chicago, New York, Denver, and so forth. I wonder if you would care to comment on the implications of that statement.

Dr. FINKLEA. I could, I suppose, ask for the source of the statement.

Senator BUCKLEY. I believe a company called Chrysler.

Dr. FINKLEA. I think the source of the statement was really a research project from the Coordinating Research Council, and people from our agency were involved in some of the technical committees which dealt with that particular project.

Dr. Stewart, who I believe was the principal investigator on the project, has himself given a paper in which his focus was that although the average carboxyhemoglobin level for nonsmokers was in general below that which would have occurred should the ambient air quality standards have been maintained, there were significant proportions of the nonsmokers in every locale whose carboxyhemoglobin levels were above that this showed that they had been exposed to levels of carboxyhemoglobin which exceeded the Federal standards. Whether or not these exposures were totally due to ambient air, or whether they involved some occupational components or some exposure to, say, cigarette smoke, could not be ascertained from that study. So in one case the study is correct, in quoting an average value. But if our goal is to protect the large proportion of the population not just the lower 50 percent, then the statement is not correct, sir.

Senator MUSKIE. Will the Senator yield?

Senator BUCKLEY. Certainly.

Senator MUSKIE. The source of that information was the Coordinating Research Council, you say. My information is that the project numbered CAM8-68, was conducted by that Council. It was made up of the following persons: The project leader was Mr. Edwin DeJongh, of General Motors. Other advisers were Keiffer Davis, of Phillips Petroleum; Walter Cohen, of the Industrial Hygiene Division of the General Motors Corp.; Mr. C. L. Samuelson, of Marathon Oil; and then Mr. Knelson, of EPA, slightly outnumbered.

Senator BIDEN. Are you suggesting they don't smoke, Mr. Chairman?

Senator MUSKIE. I am suggesting this was hardly an objective scientific project.

Dr. FINKLEA. Excuse me, Mr. Chairman, but I might disagree with you on the project group. I have worked with the Coordinating Research Council project groups in the past. I have found that where there may be a difference of opinion in interpretation of results, as was the case in the work Senator Buckley mentioned, that the scientists on these groups can work together to define what is a technically acceptable arena for disagreement.

Senator MUSKIE. I understand that. But let me make this point, and I didn't intend to trespass on the Senator's time to this extent but a wide-ranging subject has been opened up which I think is important.

The Chrysler Corp. is the one automobile manufacturer which has attacked the health basis of the standards. It relies on this publication, "Air pollution and Public Health." That publication relies to a great deal upon the alleged findings of the Coordinating Research Council report.

You have already testified this morning that your findings up to this point justify the health standards set by the 1970 act, including the definition that I read from the committee report. The Chrysler Corp. reaches precisely the opposite conclusions, relying on this publication, relying upon the findings of the Coordinatiang Research Council, to back them up, and using that data in advertisements in major newspapers in this country to attack the health basis.

The industry has indicated that it is going to attack the attack, and it is going to do so on two grounds: One, the health basis, the other their inability to meet the requirements laid down by Mr. Ruckelshaus by 1975. So it is important that we understand the source of the information they are peddling for the purpose of undermining the act.

I understand recently there was an automotive air research symposium, sponsored by the Coordinating Research Council. I have here an analysis of that symposium by the Library of Congress, Congressional Research Service. I read from it:

It appeared to me that the major emphasis during the recent automotive air pollution research symposium, which was sponsored by the Coordinating Research Council, was on the fact that the data from the experiments indicated neither cognitive nor physiological effects which could be identified as being associated with ambient levels of carbon monoxide exposure.

This is an analysis of the thrust of that symposium, conducted in March, by an interesting coincidence, during the same period Mr. Ruckelshaus was reviewing the requirements imposed upon the automotive industry.

There is further from the analysis of the symposium:

It should be emphasized that the experimenters were quick to point out during questions that their human volunteers in the case of controlled experiments and the sources of the blood samples examined in the case of blood collected from individuals during the donation of blood, were usually healthy, normal adults. Neither would the types of experiments conducted be entirely adequate as the evaluation of chronic effects of carbon monoxide on sensitive individuals.

The thrust of your testimony this morning, the thrust of the policy basis that I read from the committee report of 1970, was that in determining adverse health effects we must be concerned with the effects upon sensitive groups in the population. This symposium, according to this analysis, wasn't at all concerned. So the thrust of the research being done by the Coordinated Research Council isn't addressed to the health basis of the 1970 act at all. It is that information that is going to be peddled around this country, peddled to members of the Congress, for the purpose of attacking the health basis of the 1970 act. I think it is important to understand that.

I think it is also important to understand the makeup of the Coordinating Research Council. There are 18 directors, seven from the American Petroleum Institute, seven from the Society of Automotive Engineers, and four from EPA.

Then when you have the project directors—well, here is an example.

Another project is the study of plant damage by air pollutants. "The leader of this project is Mr. D. M. Teague, of Chrysler Motors."

Here we have several projects being conducted by this council. Here is one on composition of diesel exhaust. Here is a list of the members, the people assigned to that project. Only one is from EPA out of that long list. All the others are from such organizations as Texaco, Inc., Atlantic-Richfield Co., General Motors Corp., Caterpillar Tractor, and so on.

On all of the other project panels associated with diesel exhaust, the odor panel has no EPA representatives; the gaseous emissions panel, no EPA representatives; NO and CO measurement subpanel, no EPA representatives; hydrocarbon measurements subpanel, one EPA representative; programs-planning, no EPA representative; smoke panel, one EPA representative; meter evaluation subpanel, one EPA representative.

I don't care how objective the EPA representative may be, in that kind of an environment I am just curious as to how much influence his objective attitude may have upon the findings of the panel.

I understand that the Coordinating Research Council is in part supported by EPA, to the extent of $4 million or more. I don't know what the exact figures are, but when the Coordinating Council issues reports, it doesn't say, "The member of this Council are heavily industry-oriented."

There is a story in the Washington Post dated March 10, of this year, "Report finds carbon monoxide at high level in city smokers."

There is nothing to indicate that this report was put out by an industry heavily influenced and dominated by automobile manufacturers.

It seems to me that when EPA associates itself with such an organization, the effect is to compromise the validity of the project. I don't challenge the right of the automotive companies to conduct research of their own. But when they undertake to do so by camouflaging the sponsorship, then I think the public interest is involved.

The question arose in connection with Senator Buckley's question, but it naturally led into these other matters. I think it is important that we understand your evaluation of the Coordinating Research Council, what is its impact, what is its interest, what is the validity of its findings. I don't challenge your observation that true scientists aren't going to be compromised by the character of their sponsorship. But whether or not they are, the suspicion that they may be is very strong, when the sponsorship is of this nature.

I have been aching to get that information out into the open where we can look at it. Let's look at it.

Dr. FINKLEA. I might comment on two aspects before turning back for the policy part.

First, the studies that you alluded to dealing with carbon monoxide were studies that were undertaken by this group after review by the National Academy of Science saying what sorts of studies would be needed relating to the health effects of carbon monoxide in addition to those studies that had been done or were underway. So the types of carbon monoxide health effects sponsored by that particular group were determined by the National Academy of Science panels. They were heavily weighted toward evaluating human performance in healthy subjects since this had been the focus of concern at the time the criteria document was published and standards were developed. That particular group has been interested and involved in the effects of carbon monoxide upon people with compromised heart circulation for the last 2 years. They are doing work in this area now, but the work is not complete.

Senator MUSKIE. Doctor, both of you have said, I think understanding it because of the administration budget policy, and I understand you could use more resources, you are spending a sizable proportion of your research resources to support this activity.

Dr. FINKLEA. The involvement of the EPA with the CRC project, sir, is on a project-by-project basis. The EPA portions involved are not funded if the agency is not satisfied that this project is moving in a technically acceptable fashion and addressing a problem that is of priority interest to the agency.

Senator MUSKIE. In a sense what is involved are projects related to the performance of an industry which is heavily subject to your regulation. Is the project valid when it relates to pollutants that are critical to the regulation of that industry?

Dr. FINKLEA. I think the contractors who perform this work are, in my experience, capable investigators who are not biased any more than any other human being is biased.

Senator MUSKIE. There aren't very many such human beings. But the interpretation of the results by individual companies are an entirely different matter. I think the report you referred to is an interpretation of the research reports, not the research reports themselves.

But don't you feel that in any way the validity of the reports is compromised by the nature of the sponsorship?

Dr. GREENFIELD. May I answer that?

Senator, I think it is important that we constantly provide an arena where all sides can have something to say. I think EPA has done this in the past and will continue to do it.

I think the same thing is true in a research area as well. I think we would be subject to severe criticism if we did not permit all sides of any controversy to bring what data they have forward to be examined as well.

Senator MUSKIE. What do you say when Chrysler, in the course of this debate, says, "Look, the health basis of this act isn't well founded and we can draw upon research findings that are sponsored in part by EPA to document our charge?"

Dr. GREENFIELD. I will come back to that, but the point I was trying to make is what Dr. Finklea has said is correct. What we fund is not CRC. What we fund is joint funding of projects, specific projects, with specific researchers, to gather and do the research on the areas that we are interested in.

Senator MUSKIE. What is your rationale for electing CRC as a partner in that kind of an effort?

Dr. GREENFIELD. Because I think there is merit to having an arena where we both go after a set of data and can disagree about the interpretation of these data. All research data are subject to interpretation. I think we have to have that sort of dialog going on, trying to decide on what the meaning of these data are. I think what is proven is the fact that we have set a very stringent carbon monoxide standard.

True, Chrysler and others who have chosen to interpret those data in their own way have disagreed with us. But we feel that our position is correct. We have discussed this with them. We have argued with anybody who wants to come forward and argue it on the basis of the data, itself. We still at this point will continue to maintain our position that the standard we have set is correct.

If we suddenly turned around and said, "Yes, industry's interpretation of the data is obviously the way to go," then I think we would be subject to the type of criticism that was raised. We are not. We are arguing with them as hard as you are.

Senator MUSKIE. You see what you are forced to do this morning. You are forced to try to explain away an impression that I got from the fact that this is a heavily industry dominated research project.

In this decision Chrysler was very much on the spot on the good faith issue. Here we have the Chrysler health rationale that is the product of this Coordinating Research Council. Doesn't that lend itself to the suspicion that the decision on good faith may have been influenced by Chrysler's improper opportunity to influence the findings of the Coordinating Research Council?

I am not suggesting that. I am talking about the appearance of the thing.

Let me say this: Mr. Ruckelshaus has been faced with a very difficult decision, and it is my view that he made the decision on the merits as he saw them. It is an honest judgment. I said that at the outset and I say it still. But let me say this also, that when a decision has the effect of giving credence to an industry position, as it does—it is the natural effect of it—we have to be certain that there is no basis implying that result or that effect is influenced improperly. I am terribly concerned about this connection.

I hadn't really focused on it until last night when I had a chance to begin to dig into the basis of the arguments that Chrysler and other segments of the automobile industry are beginning to make on the health front. One of the reasons I raise it, of course, is to bring out into the open the basis of Chrysler's claim, but also to explore it.

I don't throw this at you as an accusation against it, Mr. Ruckelshaus. I seriously question the judgment of being associated with this council. I don't challenge the right of the council to be conducting research for the industry

That, of course, is its right. As a matter of fact, on television the other day I urged that if the industry challenges the health basis of the act, why don't they go out and fund a massive research project to establish their own basis.

But it is when the line crosses or appears to cross that I am concerned.

Mr. GREENFIELD. Mr. Chairman, maybe that is exactly the point. If the industry goes out and funds on its own a research program, the data that comes from that program is immediately suspect from the standpoint of all those not in the industry.

If we go out and fund a program on our own and produce a result that makes anybody else unhappy, our data are suspect in their minds. In this case, in this particular case, by jointly going out and funding the collection of these data, it does not say that we agree with the interpretation. Each group can go off and interpret it as they wish. But at least we agree that the data were collected fairly.

Senator MUSKIE. But what happens is they issue an interpretation of their data. You don't issue an interpretation of their data. You just take their data into account with all other data available to you to issue your own position.

Dr. GREENFIELD. But the data that comes out of those experiments are a part of what ultimately winds up as our standards.

Senator MUSKIE. Let me refer you again to the impression of the symposium that was held. The whole thrust of the symposium was that neither cognitive for physiological effects could be identified as being associated with ambient levels of carbon monoxide exposure.

That is what the symposium was organized to demonstrate and prove. I get the impression that the fact that the individuals who were examined were usually healthy, normal adults didn't emerge in the hearings to qualify the conclusions that were offered for public consumption, and you are a party to those interpretations.

Dr. GREENFIELD. I understand what you are saying, Mr. Chairman. Such documents as you have in front of you, the book, itself, are really public documents. It is their view of how you interpret. It is their point that is being made.

It is not a point that we agree with. It is not a point that has bearing on the way we set our standards. Our standards are set on the basis of those data and other data as well. We make our own independent interpretation. We are not catering to the public——

Senator MUSKIE. When Chrysler uses this as the basis for its advertisements, it doesn't say that EPA, although contributing to this project, disagrees with their interpretations.

Mr. RUCKELSHAUS. Nor do they say we agree.

Senator MUSKIE. But the document is replete with your involvement, and four members of EPA are on the Board of Directors.

Dr. GREENFIELD. EPA is not in the position of taking a full-page ad in the Washington Post to refute that.

Senator MUSHIE. It is because you are not that I argue that you shouldn't create the impression of being associated with and enforcing policy statements that emerge from this Council.

Dr. GREENFIELD. We are not endorsing in any way their policy statements.

Senator MUSKIE. That is what you are saying this morning, but that isn't what they said at the symposium. They allowed the fact of your association to stand as a matter of public record. They don't qualify it in any way to protect you.

Dr. GREENFIELD. Our standards are set on the public record. The criteria document we release as an agency. That is our contact with the public and it has to be that way.

Senator MUSKIE. I agree with that. What I am concerned about is that the shadow of EPA's involvement can be used and will be used to give the aura of credibility, official credibility, to statements made by Chrysler like this, challenging the health basis of the act. We, of course, have the ammunition that you give us in this hearing to counter it. But I don't know why we should give that aura of credibility.

Mr. RUCKELSHAUS. If there were any statement in that advertisement to the effect that EPA agreed with their interpretation there would be an immediate response. The other document that you have is a document of the makeup of the committees. I don't think any scientist who looks at that is therefore going to assume that EPA agrees with their interpretation of the data.

All we are saying is that because of the limitation of funds we are in a joint investigation to get the kind of research done that we need done in order to arrive at rational conclusions without as large an expenditure of money that we otherwise would have to make.

I think what Dr. Greenfield has indicated as to the need for a basic agreement on the data is extremely important.

Senator MUSKIE. Mr. Ruckelshaus, may I say first of all if you use groups like this to conduct research because your own research funds are limited, then I say the answer to that is provide adequate public funds and not lean upon industry to do this job.

Second, EPA is not just associated with particular projects involved in this blue book. The Research Advisory Committee, which is in a sense the Board of Directors of this, lists five representatives of EPA, suggesting that you have an involvement in the overall direction of the activities.

Third, this book is being circulated by Chrysler Motors all over this country to support their claim that the health basis is questionable. That leans upon the products of this research. That, to me, is a disturbing kind of association.

It doesn't undermine my respect for Mr. Ruckelshaus. I do disagree with his judgment. He wasn't the one who started this. I understand that the association with Coordinating Research Council took place before you took office.

Dr. GREENFIELD. I think it is about 3 years old.

Senator MUSKIE. I think so. But it is only within the last 7 or 8 years that we got involved in regulating the industry to the point where we should have examined this kind of association.

I repeat, I don't raise this question for the purpose of undermining my respect for you, Mr. Ruckelshaus. But I think you ought to look at this. I really think you shouldn't have this kind of association.

As far as examining the data produced, you can do that at arm's length after the fact, if they advance data to challenge your judgment. You can examine the data independently, not as a member of the group, I would take it, just as they are going to examine your data and challenge it, if they can.

Dr. GREENFIELD. You realize that there is all kinds of data you can examine. Once the data has been massaged thoroughly, all your examinations will not mean anything. What you want to do is get your hands on the raw data.

Senator MUSKIE. If I can see some evidence that EPA was in the majority on some of these panels, I would feel much better about it.

Dr. GREENFIELD. It doesn't have to be in the majority to be in association with a particular contract or grant and thereby have access to the data of that contract or grant.

Senator MUSKIE. You know, Dr. Greenfield, in the course of the last 10 years I have heard from scientists who come before us, openly speaking for the automobile industry, scientists coming before us openly speaking for the public interest. It is curious how their perspectives differ because of the sponsorship which they represent.

I am all for the scientific approach and I think scientists try to be objective. But why their perspective should change so radically when they come under a new sponsorship is an interesting development. I just think it is something you ought to be very careful about.

I have belabored this more than I should have. I thought it was important to get it out in the open.

Mr. RUCKELSHAUS. Mr. Chairman, let me make a point. I don't think there has been anybody in the regulatory agency who is not a hybrid. We are an independent regulatory agency in the light that I am appointed by the President and serve at his will, as opposed to one who serves for 4 years or what have you. Yet we are viewed by the public: I think very pointedly, as a regulatory agency.

In many respects we are like any other agency of Government, any other department of Government, with part regulatory functions and part stimulative functions in the society. Because we were viewed as a regulatory agency and because of the extreme sensitivity of the issue of the Government regulating business to abate pollution and the fact that not very much had been done, or at least that is the way it was perceived by the public in the past, I felt it was extremely important that I keep at arm's length from the industry that we were regulating.

Since I have been the Administrator of this Agency I have met twice under very carefully controlled circumstances with the presidents of these major automotive corporations. In meeting with them.

I have told them why I am not going to meet with them anymore than that because it is my opinion that I have to deal with them at arm's length if I can, to be a fair, effective, firm regulator.

By the same token, I have encouraged at the scientific level and the technical level of our Agency communication with the industries that we regulate so that we don't get in the position of issuing a standard or making a statement that simply ignores the reality of the situation or ignores data we otherwise ought to have. I have the greatest trust in the technicians and scientists in our Agency that they are going to represent the public interest.

I have told them if at any time I find out they are not doing that, they are finished in this Agency. But I want to know what claims are being made about our regulations, what claims are being made of unfairness about our standards by the industry.

I told industry scientists that if they think our health standards are no good, don't try to convince me, go talk to our scientists and convince them. They have not been able to make a dent in our assurance, in our belief, that the carbon monoxide and hydrocarbon standards are based on sound scientific and policy judgment as to where those levels ought to be.

We have had just recently this kind of dialog between Chrysler Corp. scientists and our scientists as to where those health levels ought to be.

There is a disagreement. Our scientists do not come to the same conclusions that are in that advertisement that was taken out. We continue to support the standards as set by this committee and by this Congress as to carbon monoxide and hydrocarbons, regardless of what interpretation they may place on this data. I think in my own mind there is a sharp distinction made between how I ought to keep at arm's length and the necessity for communication at the scientific and technical level in order for us to base our judgment as soundly as possible.

Senator MUSKIE. I wouldn't disagree with anything you have said. I think it is a sound policy. But I think you cross the line in appearance. I would agree that your scientists ought to be in communication with theirs.

They have a right to make their case as best they can. But I think by doing it through this media you have perhaps unwittingly created an impression of too comfortable an arrangement that serves their purpose.

You have given us your testimony this morning before this issue was raised. It is evident that you disagree with this document, Chrysler's health claims and all the rest, and you have a scientific basis for doing so. With that kind of testimony, I am not prompted to challenge your motives.

But I just challenge the judgment that led us into this arrangement. Apparently what happened is that we entered into it years ago before it became as potentially suspect as it is now, and we have continued the arrangement for the purpose of serving the objective which the Administrator has just described. I can understand the objective. I think the arrangement is still suspect.

Mr. RUCKELSHAUS. Mr. Chairman, I think I can tell you that I will reassess our association with this committee, though in my own mind it does not compromise our position. If it gives the appearance to you and possibly others that this has compromised our position, we will have to cease this association no matter what benefits we think we gain.

In my opinion if we are to be ultimately successful in acting in the public interest we have to have a very high degree of credibility. Otherwise we simply can't function. If it gives this appearance, I will reassess it.

Senator MUSKIE. I appreciate that. I think what may be involved is not an abuse of the arrangement by the agency, but an abuse of the arrangement by others who are seeking to make it serve other purposes. I think the advantage of it surfacing this morning is that we put some of the industry claims on health in a more realistic perspective. Perhaps we will get a reevaluation of the arrangement. I would appreciate that.

I apologize to Senator Buckley for having trespassed on his time.

Senator BUCKLEY. Not at all.

I will say this, Mr. Chairman, that I am less bothered by the appearances, and so on, in this case than you apparently are. It seems to me what we want is to make sure that the EPA has the most effective access to hard data on the basis of which to make its own judgments. The performance of the EPA will stand or fall depending upon whether the conclusions are well based.

First of all, may I ask this question from your point of view as scientists: Does participation on these committees make it easier for you to assess the data that is being considered?

Dr. GREENFIELD. It makes it easier for us from several standpoints. One, it gives us easier access to the data. Second, it gives us, I think, a better insight into the reasons for the interpretation placed on the data by the industry people as well.

In other words, we are in the arena where the disagreements are laid out in a much more open manner. Instead of by innuendo or secondhand or thirdhand statements, it allows us to take a look at why they are disagreeing with the position we are taking.

Senator BUCKLEY. If you set aside the question that the association might or might not have an adverse effect on public confidence in your conclusions, it is, from your point of view, an effective way of arriving at your own judgments?

Dr. GREENFIELD. I think it has been useful.

Dr. FINKLEA. It is at times a lonely task, but it is a useful association.

Senator BUCKLEY. The next thing I would like to get into is the critical importance of the validity of the health standards to the entire economy of the Nation, to say nothing of the health. How satisfied are you as to the adequacy of the data on the basis of which you have had to reach your conclusions? You are, of course, working under statutory time schedules.

Dr. FINKLEA. I think the statutes have said that we must reach certain conclusions in a certain time frame. I think having done this it is our obligation to assure that the decisions that have been made were in fact scientifically correct.

We are moving toward doing this as rapidly and as effectively as we can. I think we have shown in the material presented in the last 2 days there are many, many gaps in our scientific information. But neither those gaps nor the gaps which we have filled thus far would lead us to believe that the present ambient air quality standards, for the protection of the public health, should be relaxed.

There is one other point, Senator. Of course, the price of not having a fuller understanding is one of uncertainty as to the adequacy of the standard and the tendency toward perhaps a more stringent regulation.

Senator BUCKLEY. Rightly or wrongly, I believe wrongly, the EPA is associated in some part of the public consciousness as "them," the environmentalists. Therefore, it is possible that the EPA's conclusions might, in the public mind, be considered as partisan, as the automobile industry's conclusions.

As I say, I don't believe from the way I have seen the EPA perform that this is a proper charge or a correct charge. Would it be helpful to you or might be helpful in assuring the public that in fact the best possible decision has been made on the basis of existing data, to have an independent organization such as the NAS review your data and reach its own independent conclusions?

Dr. GREENFIELD. Senator, I seem to spend half of my life arranging for people to review our data in one form or another, to assure all parties to a decision that is about to be made that we have given it as fair exposure as possible.

We certainly use the National Academy of Science in many, many ways, in many areas, to review, to advise, to provide an outside viewpoint. We are in the process of setting up a coordinated Science Advisory Board in the Agency which would combine all our advisory committees in a way that will provide us with an external, expert overview, not only to look at the data we are reviewing, but also to look at our program itself so as to make sure that we are indeed moving in the direction that is going to solve the problems that we have to solve.

There is always a tendency, I think, in any group that is enmeshed in the problem, itself, to take a somewhat biased viewpoint because of the enmeshment, itself. We constantly have to guard against that, both from the standpoint of peer review of our results, and review by organized external groups. We have to give them a chance to examine and advise us. We do this extensively.

Dr. FINKLEA. The biological committee on the National Academy of Sciences, entitled the biological effect of air pollution, has assisted the Agency in assembling the information base upon which controls are to be based. This group, which is now being renamed and which will be part of the environmental study group within the Academy, is a group that will be reconsidering the automotive pollutants for scientific reassessment beginning the first of July in the coming fiscal year.

So I think we are utilizing just the mechanism that you advocate and have been doing so now for approximately 2 years, since EPA was formed. It is true that the criteria documents upon which the initial decisions were based were prepared by other means.

But the National Academy of Sciences is the prime mechanism for a basic review of scientific information.

Senator BUCKLEY. Is there any important element in the scientific community, to your knowledge, untainted by any connection with the automotive industry that challenged your conclusions?

Dr. FINKLEA. With respect to what problem?

Senator BUCKLEY. Setting the health standards.

Dr. FINKLEA. The existing primary ambient air quality standards?

Senator BUCKLEY. Yes.

Dr. FINKLEA. Not to my knowledge. We have had a great deal of interest and comments from the industrial sectors who will be regulated for one reason or another. We have had a great deal of expressed interest from public interest groups and people who belong to environmentalist groups, commenting on existing and proposed regulations.

I do not recall, at the moment, any one occasion in which the public interest groups were advocating a much more stringent posture with relation to the primary ambient air quality standards. Of course, these comprise only a small portion of the regulatory activities the Agency is invoved in.

Dr. GREENFIELD. In almost any activity of this sort that we engage in we ask for comments from the public. The public in this case normally is the scientific public. We will get, in addition to what you might describe as a biased viewpoint because of other interests, a considerable amount of comment from members of the scientific community on both sides of the question, either agreeing with the stringency of the standard we are suggesting or disagreeing, or demanding that it be more stringent.

We look very hard at the evidence they bring forward to back up the claim that we are either being too stringent or not stringent enough. We do not ignore any evidence.

The conclusion that we come to is based on these comments as well as our own data and our own interpreation as well. We try to take it all into account.

Senator BUCKLEY. I have heard it suggested that the ambient air quality standards should concern themselves with the presence of oxidants and not with hydrocarbons. My understanding is that the hydrocarbon forms with the NO_x to form the oxidants.

Is it possible to just deal with oxidants?

Dr. GREENFIELD. Since the oxidant is a result of the photochemical reaction, to control the oxidant once you have decided on the level of oxidant which poses a threat to health, requires that you control other substances as well.

The dominant substance is hydrocarbon. We do not talk about hydrocarbon at this point as a specific health hazard, but only in relation to the role it plays in the formation of the oxidant.

So the standard that we set for the hydrocarbon is based on its effect in producing the oxidant for which we have a health standard.

Senator BUCKLEY. Mr. Chairman, I would like to have the right to submit some questions for inclusion into the record.

Senator MUSKIE. I think you are entitled to more time. I took quite a bit of yours.

Senator BUCKLEY. I have some specific questions that went into their conclusions; I have a more general question to ask at this time.

Mr. Ruckelshaus stated yesterday or the day before, I believe, that as you get into the whole question of the health effect of pollutants you tend to find lesser and lesser amounts have an adverse effect on health.

Is this a correct understanding?

Dr. GREENFIELD. I think probably the more correct statement is that to date we have found no reason to relax the stringency of the standards that were set under the Clean Air Act.

As you look at lower and lower levels of health effects, as you gather more data, then not only the primary but possibly the secondary and tertiary effects begin to emerge.

What are the effects of low level, long-term dosages? What are the synergistic effects, the combined effects of various pollutants? As these start to emerge and you are in a lower dose level, at some point there would possibly be a more stringent standard. I think logic tells you that will occur.

Senator BUCKLEY. Does this suggestion that if we are to pursue a zero health risk policy we must think about implementing a zero emission polluant policy?

Dr. GREENFIELD. I think that is where the logical train takes you. It raises immediately the question that I don't think we as a Nation have faced up to yet, the question of social risk, and deciding what social risk really is and how do you determine it, what social risk the public is willing to take.

We do take it unconsciously in many of the things we do in our society.

We have never faced up to it as a country.

Senator BUCKLEY. If one assumes that a zero pollution policy is unachievable in an industrial society, does this suggest that we ought to be considering some trade-offs?

Dr. GREENFIELD. It is difficult to answer that question without knowing what the trade-offs are. I think you have to have the ability and the flexibility to examine what the trade-offs could be or would be and what the effect would be on society of accepting a full zero risk, zero pollutant criteria for protecting the environment.

You have to have the ability to look at these and make a decision based on having all the information in front of you. You certainly could conceive, and I think logically once again, that society has to make trade-offs. It has to decide what it is willing to pay, both economically and socially, for its health, its comfort and what-have-you.

Society has to do this all the time.

Mr. RUCKELSHAUS. I think Dr. Greenfield is saying the answer to your question is yes, Senator.

Senator BUCKLEY. Thank you very much.

I have no further questions, Mr. Chairman.

Senator DOMENICI. I have a couple of questions, Mr. Chairman. They will be on some matters other than today's testimony, just generally relating to the testimony to this point and related matters.

Let me ask first, Mr. Ruckelshaus, this question: You stated when you announced the extension of 1975 standards that if you had a remedy short of closing Chrysler you would have used it. I think you said that.

What kind of remedy did you have in mind? Do you have any legislative recommendations as to added sanction imposing powers that your Agency might need? This may be a historic first. You may not be confronted with a similar one. But I think we ought to know your feelings about what you think you need.

Mr. RUCKELSHAUS. In general, I think, in the imposition of sanctions, the more flexibility you have, the better able you are to make the punishment fit the crime. I have thought, both prior to and after the decision, what kind of sanctions might be able to have a greater deterrent on activity which I deem to be questionable and which they don't.

Frankly, the only sanctions I could think of were fines. Within a certain range, that might be effective to deter activity of this kind in the future. Clearly, if you have a punishment which is so severe that it would, in effect, as I pointed out in the decision, shut them down or penalize a lot of innocent people, it doesn't become a very good sanction because it is so difficult to impose and for that reason may not have much of a deterrent effect on that kind of activity in the future.

Senator DOMENICI. So it is correct, then, that you think you need some additional sanctions and that you are open to some consideration in that regard?

Mr. RUCKELSHAUS. Yes. I would be open to any suggestion. The only ones I can think of, frankly, are fines.

Senator DOMMENICI. On NO_x that we talked about yesterday, you said that you planned to submit legislaton to us which would grant you the discretion in setting the automotive standard.

Assuming that Congress decided that giving you that blanket authority was unwise, would you be able to tell us what percentage control would be necessary?

Mr. RUCKELSHAUS. We would certainly try. Based on Congress' former treatment of a request of that kind, I think it is probably not too difficult to predict that may be the reaction.

Again, I think by putting this analysis out for public comment, to try to get what people think about what has led me to this conclusion, we may be able to come up with a range of numbers indicating what the effect of each number would be.

Senator DOMENICI. When we make this decision, we, or whether we grant you the permission to set it, the time that we do that seems to me to be rather important in terms of the automotive industry and contentions that they need to know that in order to do other things.

From the testimony and previous sessions with them, do you have a date by which this decison must be made if we are going to be able to say that we are not causing substantial waste of resources and tooling up and the like, which would be the obvious kind of contentions?

Mr. RUCKELSHAUS. I think you have correctly pointed out the problem. Clearly, the best day would be if we knew it now. But that obviously isn't possible. One of the reasons why I suggested yesterday that I ought to publish this and open it up for public comment is I think it is very important for this committee and for the Congress to feel comfortable with what I am suggesting, that they not simply take my word for it, that this is my conclusion.

I think we have to try to bring this question to a head as quickly as possible. The only way I can see to do it is to publish the analysis that has led me to this conclusion and then simply give the Congress that analysis for them to make a decision.

We intend to publish this in the Federal Register within a week to 10 days, giving probably 45 days of comment and then some assessments of those comments, and transfering this package to the committee. That whole process would probably take about 2½ months, I guess. That is a pretty stiff time frame.

Senator DOMENICI. The reason it seems to me obvious that we must do something quickly is that your agency has a tremendous record of being fair with the American people and with us. You are very definite about the fact that the 90 percent is wrong, based on the evidence that you have.

When you do that, when you say we need to lower something, I have no doubt that you really mean we are imposing a standard that we don't need. That is what you have told us. I think whatever effort that can be made to get on with setting it is fair play on all sides.

Let me changes to the data truthfulness of the Coordinating Council.

Do I understand that you have not found any data that they accumulated in their research to have been in any way, in your opinion, affected by the nature of the scientists' relationship with the automobile industry?

Dr. FINKLEA. I think the people who have done the research for the Coordinating Research Council have made a sincere professional effort to collect the best possible information. Their relationship with the CRC involves both the industry and the Federal Government. To say that their contact with these gentlemen has not in some way affected their way of thinking would not be appropriate.

But I don't think any of them have compromised their principle in dealing with the problems involved. I think they have learned from their associations with both Government and industry scientists, and I think to that extent their outlooks may have been changed but I don't think there has been a conscious nor unconscious bias that is reflected in the information I have seen.

Senator DOMENICI. Mr. Ruckelshaus, let me ask this: With reference to our chairman's inquiries regarding advertisements and the like that come data accumulated by the Coordinating Council, is it your testimony that you have not looked into whether they have been impropitious in relating your agency to their ads and you are going to do that and try to make a decision?

Is that what you are telling us?

Mr. RUCKELSHAUS. I know of no effort in this ad or otherwise, and there may be some that I don't know, in which they try to attribute their conclusion to our Agency. If I did know of such a claim and this was not our agency's conclusion, I would say something about it very quickly.

Senator DOMENICI. Then I take it that to this point they have not formally been advised, nor do you have a formal policy, that just because you partially fund an agency that they are not permitted to attribute to your agency any of their findings or conclusions? Is that correct?

Mr. RUCKELSHAUS. I think that certainly is implicit if not explicit in any arrangement such as this. The membership of those subcommittees and the committee, itself—these are not voting committees—they simply decide what areas of research need to be done in order to fill some of the gaps that are obviously for any complete research program and those gaps that we think are important to fill we partially fund.

So whatever is done with the data is up to an individual. It can be completely misrepresented by an individual if he wants to. There is very little we can do about that.

On the other hand, if they attribute that misrepresentation to us, or what we thought was a distortion or an erroneous interpretation, I think that would be clearly improper, and if an explicit communication of that feeling needs to be made I would certainly do so.

Senator DOMENICI. One last question with reference to the data accumulated through the board council activities.

Do I understand that you have accumulated similar information and data scientific in nature from other sources completely outside of their efforts and on the same subjects? Is that correct?

Dr. GREENFIELD. That essentially is correct. We attempt to get data from in-house, or on contracts or grants, and any other source that has accumulated data that might bear on the question.

There isn't that large a research program in the country or the world that allows us to ignore any data in our search for the answers to the questions that have been raised.

Could I add one thing to the statement Mr. Ruckelshaus just gave, in all of our research support, that which totally comes out of EPA, the results always carry the statement contained in them that, "These research results do not necessarily reflect, by themselves, the policy of the Agency nor is the Agency bound by them."

This is our supported research. The interpretation of that research in terms of the function that the Agency has to do in its regulatory business comes after we get the data.

Senator DOMENICI. Thank you very much.

Thank you, Mr. Chairman.

Senator MUSKIE. In answer to Senator Domenici's question, it is important to read out of this blue book of the CRC a portion of the introduction. Let me read it.

> Constructive action to improve the environment depends in large measure on sound facts concerning the effects of our highly developed technology on the quality of the air we breathe. The Coordinating Research Council Air Pollution Research Program, underway since 1968, represents a unique joining together of the resources of private industry and the Federal Government to explore one aspect of the overall environmental problem, atmospheric pollution due to vehicle sources.
>
> Experts in all phases of science, engineering and medicine, from the automotive industry, petroleum industry and the Federal Government are cooperating in a broad range of studies. This close liaison between industry and government on a matter of growing public interest ensures that the information developed by the program would meet the needs of all concerned.
>
> To automotive and petroleum engineers it means having access to objective data that can be used by the individual companies to further reduce vehicle emissions through improved equipment and fuels, and for Federal, State and local government agencies it means receiving impartial data on which to establish emission standards and air quality implementation plans.

I don't know who produced the rhetoric, but there it is.

I would like now, if we may, to get into the good faith question which we undertook to schedule for this morning.

Mr. RUCKELSHAUS. Is it all right to have these two gentlemen excused?

Senator MUSKIE. Of course.

First, Mr. Ruckelshaus, I would like to get into the basis for the good faith issue.

On the first page of your full decision, the introduction, you lay out the language of section 202(b)(5) of the act, which spells out the conditions for granting an expension of time. They are in this order: Public interest, good faith efforts, the availability of effective technology, and then the NAS study.

In your judgment, does each of these conditions stand on its own legs or can they influence each other? For example, if you were to find somewhere less than all good faith effort, would you, in your judgment, offset that finding by finding that the public interest nevertheless dictates the extension?

Mr. RUCKELSHAUS. No.

Senator MUSKIE. Did you regard each of these conditions as standing on its own legs?

Mr. RUCKELSHAUS. I don't think each of them does. I do think the good faith argument does. I think I must make a finding that there has been good faith effort in order to grant an extension to any single applicant.

Senator MUSKIE. So you must make a finding that there was a good faith effort?

Mr. RUCKELSHAUS. That is right.

Senator MUSKIE. What, if any, was the impact of the court decision on that decision?

May I say at the outset I would like to refer to two portions of your decision that relate to that and then ask you to comment, if I may.

As I read your decision, it seems to be carefully structured to meet what you believe to be the requirements, in all aspects being carefully structured to do that. It is obvious that the court decision had an impact upon your evaluation of your responsibilities under the act.

Mr. RUCKELSHAUS. That is correct.

Senator MUSKIE. If we have not already done it, I think the court decision ought to be made a part of this record for that reason.

[The court decision referred to may be found at p. 348, appendix.]

Senator MUSKIE. There are two key paragraphs on page 5 of your decision which indicate that. Let me read two excerpts. The first is in the first paragraph on the top of page 5.

> The court has required a high degree of confidence that 1975 standards can be achieved and has cautioned that a decision to deny suspension to the extent it is based on predictions of technological availability as opposed to direct evidence, must be supported by a detailed showing that the methodology underlying the prediction is reasonable and reliable.

In the next paragraph is this language:

> In my view, the court's opinion correctly emphasizes that my decision should be designed to bring about ultimate achievement of the statutory standards by 1976. The court has also emphasized that the statutory authority to suspend the standards and to set interim standards during 1975 should be used as a safety valve to minimize the risk of serious economic consequences when the necessary technology is first introduced.

I take it that that last segment reflects the view on your part that the court substantially changed what you believed to be the emphasis of the act in respect to your duty under the act.

Mr. RUCKELSHAUS. I don't know if I would use the word "substantially," but I do think that the court did change my interpretation of the act as announced in my decision of last May.

Senator MUSKIE. And specifically with respect to the good faith test?

Mr. RUCKELSHAUS. No. In one respect did it change it as to good faith. Really it changed it more in terms of the definition and expansion that the court gave to the public interest aspect of the statute, itself. They greatly expanded what was meant by public interest, in my opinion.

In the good faith issue they changed my interpretation of the act somewhat by the court pointing out that in preparing a decision a good deal of attention had to be given to the effects of an erroneous decision to deny as opposed to an erroneous decision to grant, in weighing whether you should grant or not.

Using that test and a lot of similar tests that have been adopted by courts, in looking at a criteria of good faith you should not only look at what we normally consider to be good faith, but also what are the results of a determination that bad faith was shown. That is why in the decision, itself, I indicated that if the results were a nuclear deterrent sort of sanction, then the standard that I had to use to find bad faith had to be very severe.

Senator MUSKIE. I think that is reflected in this language on page 41 where you say, "I am placing decisive reliance upon the consideration that the sanction that arises from a negative finding on this issue with respect to a particular manufacturer could force that manufacturer to close down in 1975."

Let me ask this question: If the sanction of fines had been available to you, would you have found good faith?

Mr. RUCKELSHAUS. I indicate in the opinion I may well not have. I think to go further than that to a certain extent may over-rely on the impact of the ultimate sanction and throw some questionable light on the legality of what the decision was.

Senator MUSKIE. I asked the question not to put you in a dilemma, but I think it is an obvious implication from what you said, that if you had a lesser sanction that you could apply you might well have found bad faith.

What the question raises is this issue: When an industry achieves the size of this one, it is the implication of this decision that it is beyond the law, that there is no effective way that we can police it, that there is no effective way that we can punish it for failing to meet a public policy requirement with which it disagrees, which it challenges, which it resists?

Mr. RUCKELSHAUS. No; I don't think so.

Senator MUSKIE. Obviously there are many jobs involved. We have both used the figure that this industry represents one-fifth of our economy. Maybe it is more than that. You say you are reluctant to find bad faith because a negative finding would force that manufacturer to close down and create extreme hardship for large numbers of innocent employees of the manufacturer.

The industry has said to us, "Well, all right, find that we haven't met the requirements of law. What are you going to do, shut us down?" Is that a reflection that exists?

Mr. RUCKELSHAUS. I think, Senator, that there are effective deterrents and punishments that can be fashioned to control an industry of this size, or any size. I suggested in my mind what some of them might be to Senator Domenici.

I think in other places in the act where we have the authority to fine and where we have exercised that authority with some degree of vigor in the past, as recently as last summer, that those are effective, that they do work.

In looking at the final nature of the sanction as I view it, that it is in the good faith section, I think there is some question as to how effective a deterrent that is to force an industry to do anything because of the size of it.

Senator MUSKIE. The effectiveness of the sanction, of course, is always in question, whether we are dealing with an industry that is one-fifth of the economy or one citizen. The question involved is whether the nature of the sanction has a disproportionate influence on the finding of good or bad faith in the first instance.

I have read carefully your decision and the appendix dealing with good faith. It seems to me that the basis for finding bad faith is very strong.

Mr. RUCKELSHAUS. I agree.

Senator MUSKIE. And you, yourself, indicated reservations about it. You say, "I conclude with serious reservations." If there are reservations about good faith can there conceivably be good faith? Doesn't good faith imply the absence of reservations?

Mr. RUCKELSHAUS. If under the law you must find someone has violated a standard by a preponderance of the evidence, you may come right up to 50 percent and not go over to the 51 where it would be a preponderance and have very serious reservations as to why you shouldn't go the extra 1 percent.

Senator MUSKIE. Isn't a finding of good faith something different from finding a verdict of not guilty of a crime? There you have to prove a crime beyond all reasonable doubt. So in the face of a lot of evidence pointing toward the commission of a crime, you must find beyond reasonable doubt for a finding of a verdict of guilty.

The finding of good faith is something different. Good faith, as you know, means an effort beyond doubt, it seems to me, to try to achieve the result. The reason we wrote good faith into the law is because of the history of industry resistance for some 10 or 15 years before, the consent decree and all of the activities therein alleged in connection with that court action.

It seems to me that good faith should be demonstrated beyond doubt, that it iss omething more than simply a finding of no bad faith.

Mr. RUCKELSHAUS. Senator, I——

Senator MUSKIE. I understand your pragmatic condition——

Mr. RUCKELSHAUS. You are putting me in the position of defending someone I don't feel very comfortable defending.

Senator MUSKIE. I remember something I said to the companies when I met, hopefully under the same controlled conditions that you attempted to establish for yourself, and I said,

> Gentlemen, if I have to defend an extension of time you had better give me a good case to defend because the effect of the law is to impose upon Mr. Ruckelshaus, and in a sense upon the rest of us, the burden of defending you if you should be given the benefit of an extension.

Frankly, they haven't given me a case I am prepared to defend.

They have given you a case that makes you uncomfortable. I think maybe that is the best commentary on the good faith issue.

I yield to Senator Buckley at this point before I get into further details on this.

Senator BUCKLEY. I suspect, Mr. Chairman, that Mr. Ruckelshaus has felt he had to exercise the same kind of prudence with respect to the finding of good faith that the court in its turn found it had to exercise in setting the rule about the relative impact of an erroneous decision.

I gather from what you say, speaking of the exercise of prudence on the part of the court of appeals, that its standard that the risk of an erroneous denial of an extension has caused you to make a decision that you otherwise would not have made?

Mr. RUCKELSHAUS. I think that was in part responsible for it, Senator, although by no means the only reason for the decision. As we attempted to show in the charts which were attached to the decision, itself, there is a slight impact of this 1-year delay on air quality nationwide.

In reference again to the part of the decision that Senator Muskie noted on page 5, again we believe that is one of the dictates that the court put on us in order to make a decision. I think the court was saying the difference is slight, even if you leave the standard at the 1973–74 level.

The difference is obviously somewhat greater than where it is and where we set the interim standard. I think the decision in fact buttresses the court's weighing process where an erroneous denial doesn't have the impact of an erroneous grant.

Senator BUCKLEY. There has been a good deal of discussion of Chrysler's enthusiasm for the clean air standards, or lack thereof. In your view, is Chrysler capable of meeting the 1975 standards both in California and elsewhere?

Mr. RUCKELSHAUS. Yes, they are.

Senator BUCKLEY. It has been called to my attention that Chrysler confirms that, that they can in fact meet that standard.

Mr. RUCKELSHAUS. There must have been an agonizing reappraisal of their position.

Senator BUCKLEY. We will meet any standards that can be met by the rest of the American automobile industry.

Mr. RUCKELSHAUS. Well, that is not the same thing.

Senator BUCKLEY. Does this suggest that you will reconsider your decision?

Mr. RUCKELSHAUS. It does not. Not unless I am ordered to do so.

Senator BUCKLEY. Mr. Chairman, if I may go back to another topic other than the Chrysler one, we spoke yesterday and the day before of the possible consequences of the decision in focusing the total energies of the automobile industry on the catalytic approach.

You stated your confidence that in due course market pressures and the demand for a high standard will have the effect of having the domestic industry search out and focus on what is ultimately best.

Do you believe that this committee should consider any positive action which would serve to encourage this process of the development of alternative technologies?

Mr. RUCKELSHAUS. Yes. I do think if there is anything the committee can do to encourage a positive approach to the consideration of alternative technologies, I think they should.

I must confess after sitting through the hearings and asking what commitments might be made, given the competitive nature of the industry, my own view is the only thing that ultimately is going to force an aggressive look at alternatives is the consumer's choice of an alternative different from the one that is presently being marketed by one of the companies.

Senator BUCKLEY. We do know, of course, that by tinkering with the tax structure it is possible sometimes to make shifts in economics that do or do not achieve the intended purposes. You have any thoughts on this?

Mr. RUCKELSHAUS. We have looked at a lot of ways and are continuing to look at a lot of ways of incentives and disincentives through the tax system or through some method of effluent or emission charges.

The disadvantages to all of them is there are problems with all of them, not the least of which is getting a widespread acceptance of it in the committees of the Congress.

Senator BUCKLEY. In connection with this hearing, you are forced to operate within the constraints of the legislation. Nevertheless, you are the head of an agency that has to take into consideration far broader considerations, including not only conservation of energy but the environment as a whole. Do you believe that this committee or some committee ought to be considering more carefully the fuel penalty consequences of car weights, air-conditioning, and so on?

Mr. RUCKELSHAUS. Yes. I think this committee or subcommittee certainly should be doing that.

Senator BUCKLEY. As part of the intelligent decisionmaking relating to, among other things, our emission standards?

Mr. RUCKELSHAUS. Yes. I think the importance is to put the emission impact on fuel in context with all of the other things that cause fuel penalties, through transportation schemes of all kinds.

Senator BUCKLEY. Thank you very much.

I have no further questions at this times, Mr. Chairman.

Senator MUSKIE. With respect to the good faith question, the resolving of that question did not involve consideration of anything that happened prior to the enactment of the 1970 law. In other words, you were not concerned about the implications of the consent decree or the failures, whatever they might be, of the industry prior to that day?

Mr. RUCKELSHAUS. No, I don't think so, Mr. Chairman. I don't think I was permitted to look back into the past to see what happened with these companies and their efforts to achieve these or any other standards.

Senator MUSKIE. With respect to their activity since 1970, I gather the question of good faith could be focused on their efforts in connection with the catalyst?

Mr. RUCKELSHAUS. Yes, but in general their total program to achieve the dictates of the statute I think were relevant and important considerations.

Senator MUSKIE. But at some point in the discussion of good faith you made the point that "The manufacturers generally may have demonstrated undue conservatism or the lack of foresight in not pursuing alternate systems more vigorously."

Mr. Ruckelshaus. Yes.

Senator Muskie. So I got the impression from that that since their pursuit of the catalyst, with the possible exception of Chrysler, was vigorous in terms of their expenditures of funds and so on, that you found good faith, and the evidence of good faith was pretty much related to their activities in behalf of the catalyst.

Mr. Ruckelshaus. In my own mind you have to distinguish between what may be bad business judgment and what may be bad faith. The companies continue to maintain that the catalyst technology, the technology they have pursued since 1971, is the best technology to achieve this standard. They may ultimately be proven to be right. So not only would they not be in bad faith, but they may also have exercised good business judgment.

Senator Muskie. You say this, "It seems fairly clear now that if these companies had begun early in 1971 to develop a capability to produce other kinds of engines, and particularly the stratified charge type engine developed by Honda, large numbers of 1975 automobiles could probably achieve the statutory standards."

Mr. Ruckelshaus. That is right.

Senator Muskie. Since they did not undertake that kind of effort behind alternate engines, the evidence of their effort in that connection surely didn't bear upon the question of good faith.

Mr. Ruckelshaus. The next session after that reads: "I recognize, however, that in making this criticism of the manufacturer's developmental program I am aided by hindsight."

Senator Muskie. Let me put it this way: If they had not developed a catalyst which in your judgment would be effective—and you made it clear in your decision that you believed it would be effective—so they did not have a catalyst option, then the activities in behalf of the alternative engine would not support a finding of good faith?

Mr. Ruckelshaus. Assuming the alternatives were well known to them and there was no apparent reason for them not to pursue these alternatives because of the advance of another technology they felt would achieve the standards, then I think I would have had to look at it in a different light.

Senator Muskie. It is clear from the record, I think, that the diesels certainly were known to them, and the evidence I put in the record the other day on the development of the stratified charged engine in the late 1950's indicates that was known. You have said here that they did not pursue those two options after 1970 so the finding of good faith has to be based on their activities with respect to the catalyst.

Let me put it another way: I am not trying to play games with words. It is your interpretation of good faith, therefore, that they did not have to demonstrate a meaningful effort across the board to develop other options in addition to the catalysts?

Mr. Ruckelshaus. I think it depends in part on how available they thought those options really were. We are not saying today that as of 1971 any domestic automobile company should have known that the stratified charged engine was going to be able to meet the 1975 standards in order to meet the basic demand by that date or shortly thereafter. In fact, they had some serious questions about the Honda technology not only then but subsequent to that time, and expressed them again at the hearing.

The questions that we continue to have about the odor and particulate the problems of the diesel don't lead me to conclude either as of 1971 or today that they should have known then that these technologies were clearly superior and were capable of achieving the standard by 1975 so that if they did proceed to pursue them, coupled with the fact that the catalyst was something about which they had a good deal of confidence, that they are therefore in bad faith.

Senator MUSKIE. Let me point out that in the confidential memorandum from the Justice Department, which was put into the Congressional Record (see p. 145), there is this description of the stratified charged engine. It says, "Moreover, the stratified charged engine which would replace the conventional engine with little or no additional cost to the consumer * * * the development of this engine was publicized generally in the late 1950's so that the automobile manufacturers knew of the existence and what it would do."

What it would do was this: "Reduce hydrocarbon, carbon monoxide and oxide emissions while at the same time effecting a saving in gasoline consumption."

This was in the late 1950's. I doubt in the late fifties the catalyst technology was developed to the point where it was the obvious choice over such technology as the stratified charged engine. Indeed, in their testimony before this subcommittee in 1964, the industry definitely looked down its nose at the catalytic converter. They said they would clean up the engine. They weren't interested in add-ons. They weren't interested in promoting the hardware sales of these independent companies. They were going to clean up the engine.

In 1964 two of the options available to them were the stratified charge engine and the diesel engine. I suspect they were at least as encouraging a possibility for solving their problem as the catalytic converter in the early 1960's. They have never pursued either one. There is no evidence they have pursued either one since that time. But they have pursued the converter. They are lucky, in my opinion, that they have reached the point where they have satisfied you as to the effectiveness of the converter because that helped you to find them in good faith, with your reservation about Chrysler, in meeting the effort requirement of the 1970 act.

The question I raise long term is suppose—I think we have to go and vote. We will be right back. We won't hold you too long.

[Brief recess.]

Senator MUSKIE. The subcommittee will be in order.

You recall, Mr. Ruckelshaus, in my opening statement I referred to testimony by the automobile industry in 1964 before the subcommittee, in which they urged us to set performance standards and not design standards. It has been one of our frustrations ever since that they have indicated so little interest in developing the range of technological options beyond the catalytic converter. I think the history of their efforts is replete with evidence that they simply haven't given it any kind of push at all.

Your statement on page 42 is no surprise. It is consistent with our impressions generally.

I guess what I would say is that although in terms of finally getting behind the catalytic converter, which they were so negative about in the sixties, they finally made an effort that satisfied the good faith test. I don't think they made a good faith effort to explore these other alternatives. I suspect from what I hear that may also be true of the Japanese automobile industry, and the stratified charged engine may have been the product of a maverick; I don't know. But there seems to have been so little effect on an industry which prides itself upon having been innovative and creative over all of its history—little effect that stimulated it to provide the same capacity for innovation and creativity in this field. Does that conform to your impression?

Mr. RUCKELSHAUS. I think, Senator. It does. I try to be as objective as possible in viewing this industry. It is not always the easiest thing in the world.

I think two things dictate against their doing that. One is the importance they place on the initial cost of a vehicle as a competitive part of their vision of how they grow as an industry, so that any add-on device or even the development of a new device that would add any additional cost to any single year of an engine or of a class of automobiles is resisted very strongly. They pay, as I view it, not nearly as much attention to operating and maintenance costs, the kinds of things that might make a diesel engine more attractive as they do initial cost.

Also, particularly with the introduction of the foreign automobiles, there is the intense competition that goes on in the industry which dictates against their going forward in any area where their competitors aren't forced to do so at the same pace. So you are not likely to find innovative systems on an automobile for a social purpose as opposed to what they think gives them a competitive advantage.

Senator MUSKIE. You take your own good faith analysis of what they have done, and I think you have shown the good faith analysis, going to the fuel penalty issue, the drivability issue, and you have minimized all those what I would regard as penalties that are associated with their choice of the converter as their answer to the problem. And yet the industry, itself, is the harshest judge of those penalties.

Here is this advertisement by Mobil. "The 66 billion dollar mistake." We learned about the $150 billion mistake yesterday on the other side. See what this advertisement says about the choice of the catalytic converter.

> Mobil's analysis of current technology indicates that if Federal level cars could be built, their emission control systems would be so complicated and demanding that the cars could cost several hundred dollars more than present cars, consume considerably more gasoline than today's car, need frequent and costly tune-ups and maintenance to keep their emission control systems operating, present drivability problems with a tendency to stutter, stammer and stall, which could become a safety hazard.

(A copy of the ad referred to by Senator Muskie appears opposite this page:)

Senator MUSKIE. This isn't your evaluation. This isn't something I said about the catalyst. This is something said by the oil industry.

I see the automobile industry is unhappy about your decision. Why don't they get after Mobil? Mobil is much tougher on them, on their choice of technology, then you.

I assume you don't agree with that analysis.

The $66 billion mistake

In 1970, Congress passed a series of amendments to the Clean Air Act One of them said that all cars sold in the U S after 1974 must be near-zero polluters

It sounded fine Near-perfect emission control seemed not only desirable, but imperative At that time, people widely assumed that the air was getting steadily dirtier because of the automobile Most people also assumed that industry could solve any technical problems that might be encountered—and at a reasonable cost

The goal has proved elusive Despite the expenditure of hundreds of millions of dollars, and uncounted hours of research and development time, no control system that meets all the requirements of the federal standards has yet been proved

Bad news? Not necessarily Today both industry and government have the benefit of research results and other information that were simply not available when Congress passed its amendment in 1970

Today we know that

• Total air pollution from cars has already been rolled back to the level of about 1960, and is continuing to drop

• Cars that met the federal standards would probably be poor performers and gasoline-guzzlers They also could need costlier maintenance than today's cars

• A less restrictive level of controls on automotive emissions would do very nearly as much for air quality as the federal standards would

• Meeting the federal standards could cost $100 billion over the ten years starting in 1976; meeting the less restrictive standards could cost $34 billion. The difference could be a $66 billion mistake.

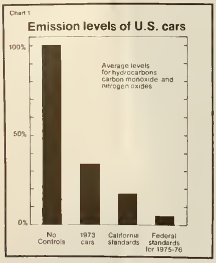
If not perfection, what?

The only way to completely eliminate auto pollution would be to do away with the auto itself Since this would be neither practical nor desirable, what percentage reduction of emissions should we aim at? By what date? And at what cost?

The goal should be to make the auto as small a contributor to air pollution as technology allows—but without incurring exorbitant costs for dubious results Since technology does not stand still, this would be a moving goal Today's impractical dream often can be tomorrow's reality

Today's reality in automotive pollution control is, in fact, yesterday's dream As Chart 1 indicates, emissions of hydrocarbons, carbon monoxide, and nitrogen oxides have been drastically reduced from the days (not long ago) when exhaust emissions were uncontrolled Changes in engine design plus

Chart 1



pollution-control devices have reduced emissions by 1973-model cars an average of 66%

This is quite an achievement And as a result, total air pollution from automobiles has been declining in the United States since 1968, and is now down to the levels of about 1960 It would continue to decline for several more years even if no further controls were imposed, as old cars with few if any controls are scrapped

So How much further should we go? And by when?

California has a better way

The Air Resources Board of the State of California (and who has more auto-related air-pollution problems, or has had more experience dealing with them?) has proposed automotive emission-control levels based on air-quality standards calculated to restore the atmosphere of Los Angeles to its quality of the early 1940s California proposes to cut the three principal auto emissions by an average of 83%

Mobil has been engaged in intensive auto-emission research for several years We were the co-founder (with Ford Motor Company) of the Inter-Industry Emission Control program, or IIEC, which is probably the largest private cooperative research program of its kind in the world So Mobil knows something about the problem, too. We believe the California standards can be achieved with in-sight technology, at a reasonable cost

The California standards are similar to those proposed by the federal government's own Department of Health, Education and Welfare in 1970

The HEW standards were not accepted Instead, Congress voted for the last bar on Chart 1 The Clean Air Act now mandates that the three emissions be reduced by 97%, 96%, and 93%—for an average of 95%

These levels must be reached by 1975 for hydrocarbons and carbon monoxide, and by 1976 for oxides of nitrogen, unless the federal government grants an extension

AUTO EMISSION REDUCTIONS BELOW PRE-CONTROL LEVELS

	Hydro-Carbons	Carbon Monoxide	Oxides of Nitrogen
1973 Cars	80%	69%	50%
California	94	81	75
Federal	97	96	93

A 95% reduction in emissions may not seem much more difficult to achieve than an 83% reduction But did you ever try to wring the last drop of water out of a wet towel? One good twist and most of the water flows out Another hard twist and a little more dribbles out But now the law of diminishing returns sets in. It's just plain impossible to wring the towel dry, and not worth the effort

Similarly, the last few percentage points of automotive emission control are far costlier and far more difficult to achieve than the first 80 to 85 points

Almost every day, we read in the newspapers about some sensational new device that will cut auto pollution virtually to zero Mobil technical people have investigated many of these devices A few offer exciting possibilities, given time for development But none has yet demonstrated it will be ready to meet federal requirements in the short time remaining

Sneak preview: your '76-model car

Mobil's analysis of current technology indicates that if federal-level cars could be built, their emission-control systems would be so complicated and demanding that the cars could

• Cost several hundred dollars more than present cars

• Consume considerably more gasoline than today's cars

• Need frequent and costly tune-ups and maintenance to keep their emission-control systems operating

• Present difficult driveability problems, with a tendency to stuffer, stammer, and stall—which could become a safety hazard.

On the other hand, cars built to the California standards will cost less to buy and to operate, and will perform better, than cars built to the federal standards

Mobil sells gasoline, but we have no desire to see our products wasted Cars built to the federal standards could consume as much as 15% more gasoline per mile than cars built to the California standards That 15% would require refining an extra 30 million barrels of crude oil in 1976, and an extra 150 million barrels a year by 1980 All that crude oil would have to be imported, with a substantial—and unnecessary—drain on our country's balance of payments

Catalysts would be necessary to meet the federal standards From 1975 through 1980 the auto industry apparently will have to import some 10,000,000 ounces of platinum and some other noble metals for catalysts—for a cumulative balance-of-payments drain of at least $1,300,000,000, based on present prices

The motorist also would need to replace the catalyst as it deteriorated—perhaps every 20,000 or 25,000 miles

About the safety aspect Dr Arie J Haagen-Smit, chairman of the California Air Resources Board, offers this chilling caution "The driveability problems such cars will present may become clear to a motorist only at the worst possible time—when he comes up the ramp to swing into 70-mile-an-hour freeway traffic A stumble then may be the last mistake he'll ever make"

The gap between the emission reductions that could be achieved by the California and the federal standards would be very small, for several years at least

It could turn out to be very small indeed, because the complicated systems needed to meet the federal standards could break down more easily—and if they did, the car's emission-control system could become completely ineffective

Up the Matterhorn

Which brings us to Chart 2 The one with a curve that looks like the southeastern slope of the Matterhorn

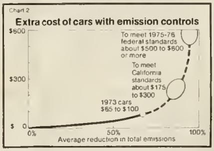
Control equipment to meet the 1973 standards adds about $65 to $100 to the cost of a new car Not excessive, considering how far the cars have come in reducing harmful emissions

The price curve turns up to meet the California standards—to a range of $175 to $300 per car for the control equipment Perhaps still not too expensive, considering the extra gains in pollution reduction

But to reach the federal standards that are now the law for 1975 and 1976 models, the cost curve heads almost straight up These systems could cost $500 to $600 a car—and maybe more We can't determine the exact cost, since systems to meet the 1976 standards have not been proved

These are just the initial costs of the emission-control systems Add the extra maintenance and throw in the additional gasoline, and the grand total

Chart 2



for meeting the federal standards comes to $100 billion over the decade starting in 1976.

Add the same expenses for the California standards, and the grand total is $34 billion (All these figures are Mobil engineers' estimates, expressed in today's dollars)

Our calculations do not include a cost for the special kind of gasoline that would be needed to meet the federal standards

Clean air and public transportation

Is there a better way to spend all or part of $66 billion to reduce total automotive air pollution?

There is indeed Public transportation Public transportation clean enough, safe enough, fast enough, and priced attractively enough to induce Americans to use their automobiles less and public transportation more

For $66 billion we could build 44 public transportation systems such as BART (Bay Area Rapid Transit system) in San Francisco. Or 22 subway systems like the Metro now under construction in Washington, D C If the country finds it doesn't want or need that many subways or BART-type systems, there are other forms of public transportation to keep in mind. Express bus lanes on freeways are one of the most efficient of all ways to move people Also, as everyone knows, America's commuter and longer-haul railroads urgently need modernizing

As we said in October, 1970. "Providing for our future transportation needs will require very large expenditures We believe there's an urgent need for legislators to re-examine the procedures used to generate and expend transportation revenues"

To achieve this, we said in January, 1972, "Congress should enact a National Master Transportation Program"

What would $66,000,000,000 buy?

The program Mobil outlines in this report could save the American consumer $66 billion over ten years That's far too much money for most of us to comprehend But here are a few things $66 billion could do:

• Build the water-treatment plants needed for all the country's household, municipal, and industrial sewage and waste water—and maintain those facilities for more than five years

• Nearly pay the annual U.S expenditures for all health and medical care ($67 billion in 1970)

• More than finance all new private and public housing construction in this country for two years (1970 total $30 billion)

• Almost pay the total cost of all types of education in the U S , at all levels, for a year (1970 total $69 billion)

• Buy various combinations of subways, BART systems, commuter trains, longer-haul railroads, and express lanes for buses on freeways

More and better public transportation can go a long way toward several desirable objectives: Less air pollution Less waste of gasoline Less pressure on the U S balance of payments as our imports of oil inevitably rise And maybe less emotional strain on motorists and fewer accidents

The critical fourth dimension

Companies in various industries are developing emission-control systems and testing them for durability and economy Some of these systems offer exciting possibilities for reducing emissions to very low levels at a reasonable cost But the most critical element is time—time to test various devices and systems for thousands of miles and to engineer the systems for mass production

The dilemma as we see it is that the federal government has legislated results by a specified date without knowing how or at what cost they could be achieved, if at all Here is a program we believe will get the country off the horns of this dilemma

1 The Environmental Protection Agency should grant a one-year extension of the present federal standards, as provided in the Claan Air Act

2 Congress should re-examine that act We hope a thorough analysis will convince the members to amend the act to mandate emission levels closer to those California proposed.

3 The federal government should continue to monitor air quality levels, and to sponsor research into the impact of emissions from all sources on health and well-being If car-population trends or other data should indicate a future need for further reductions in auto emissions, new standards should be set

4 The automotive, petroleum, and related industries should be required to continue at a high level their research and development programs on emission-control systems to reduce costs and increase efficiency

5 The Congress should proceed forthwith to enact a National Master Transportation Program to enable people (and goods) to move fast, safely, comfortably, and at reasonable cost on a first-class system of public transportation adequately supported by Congressional appropriations

Under such a program, motorists could drive better-performing, less expensive, and safer cars A substantial drain on the U S balance of payments, for crude oil and platinum, would be avoided A vital and scarce natural resource—petroleum—would be conserved And the advance of technology would enable auto makers to meet even stricter control standards—if they were found necessary at some future date—with durable, trouble-free, and reasonably economic systems

Not to mention avoiding a $66 billion mistake

Mobil®

This advertisement appeared in The Chicago *Tribune*, The Los Angeles *Times*, The New York *Times*, *The Wall Street Journal*, and The Washington *Post*.

Mr. RUCKELSHAUS. Mobil does not want to produce leadfree gasoline which has to be used to make the catalyst work.

Senator MUSKIE. I am glad you brought up the question of the leadfree gasoline. I wanted to make sure we addressed it.

Are you satisfied that leadfree gasoline will be produced to implement your decision?

Mr. RUCKELSHAUS. Yes. Every indication we have from the petroleum industry is that they can provide one brand of lead-free gasoline by mid-1974, make it generally available. There are brands of leadfree gasoline currently being marketed in the Eastern part of the United States by some members of the petroleum industry. We think they can achieve this.

Senator MUSKIE. Incidentally, I can't resist reading Chrysler's evaluation of the catalytic converter. This is their testimony before you. That ought to be read.

> The cost penalty will amount to hundreds of dollars a vehicle. The control systems are unreliable and widespread failure may lead to a consumer backlash. The catalysts will require large amount of platinum and palladium, expensive metals available only from South Africa and Russia. Cars equipped with catalysts must run on more costly leadfree gas. The fuel penalty will increase the drain on our natural resources and worsen an already serious balance of payments problem as we import additional oil.

With that kind of evidence before it, for the life of me I fail to see how Chrysler could in good faith neglect the development of alternative engine systems.

Mr. RUCKELSHAUS. I think they elected to try to get alternative standards.

Senator MUSKIE. I am just puzzled as to how they can put out this drive and convince anybody that they made a good faith effort to solve this problem. It is incredible to me.

I am sure there are questions that I have overlooked. I know I have a stack of them here. I will not plow through them to pull out those that have not been touched upon.

I think in general these 3 days of hearings have given us a very useful insight into the basis for your decision. I think it was a pragmatic decision, to take a description out of one of the editorials I read on it, and I think it represents what you believe to be the best judgment and honest judgment for you to do.

That still doesn't tell us what we should do as to the future because your options were limited to those given you by statute and by the facts that you have. It also doesn't deal with the campaign the industry is about to launch against the act, possibly against your decision. So all of that lies ahead of us. These hearings, I think were as important for the purpose of laying the groundwork for this uncertain future as it was to give us insights as to the basis of your decision.

I do have this closing statement which ties in with my opening one.

At the outset of these hearings, I indicated that I was seeking enlightenment as to why the American auto industry had failed to meet the requirements of the Clean Air Act. I also indicated that the Administrator's decision involved some very poor choices. It is clear that you don't agree that all those choices were poor as I might have suggested when I made that statement.

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These hearings have been enlightening and they do underscore the choices which did confront the Administrator. I would like to examine those choices.

The auto industry claims that emission controls will result in significant fuel penalties, but they refused to consider more fuel efficient alternatives.

The auto industry claims emission controls impose unacceptable costs on the American public—but they refused to consider alternatives which would have saved the American public as much as $150 billion.

The auto industry claims emission controls are inconsistent with public demands for performance, comfort, and style—but they have never offered the American public a choice.

The arrogance of the industry is best summed up in a statement by S. L. Terry, a vice president of Chrysler at the end of EPA's hearing:

> We have introduced evidence showing the substantial fuel cost penalty from these control systems. It is true that options such as air conditioning and automatic transmissions also affect gasoline mileage. But it is one thing for manufacturers to provide optional equipment which is a choice of the customer. It is quite another for a government agency to mandate a control system which goes beyond the need to protect public health and which imposes a fuel penalty on every car which the customer cannot avoid.

I regret that basis for public or private policy. We are concerned about the health of people who cannot participate in the "choices" Mr. Terry sets forth.

We are concerned about the 50 percent of the American people who don't drive cars, the very old and the very young, and people who are most susceptible to the adverse effects of air pollution. Mr. Terry is not concerned about them because they are not his customers.

I can only conclude on the basis of the evidence presented thus far, that the auto industry has ignored this objective. The burden continues to be on them to convince the Congress that they have not.

I appreciate the time and the patience you have given us, Mr. Ruckelshaus, and I hope these hearings have produced from your point of view as well as ours.

Mr. RUCKELSHAUS. Thank you, Mr. Chairman. It has been, I believe, very useful to us.

[Whereupon, at 12:40 p.m., the hearing was recessed, subject to the call of the Chair.]

APPENDIX

Material referred to during the hearings and submitted for inclusion in the record

Report by the Committee on Motor Vehicle Emissions

NATIONAL ACADEMY OF SCIENCES
WASHINGTON, D.C.

NATIONAL ACADEMY OF SCIENCES

OFFICE OF THE PRESIDENT
2101 CONSTITUTION AVENUE
WASHINGTON, D.C. 20418

February 15, 1973

The President of the Senate
The Speaker of the House of Representatives
The Administrator of the Environmental Protection Agency

Sirs:

I have the honor to transmit a report summarizing the work and findings of our Committee on Motor Vehicle Emissions in accord with the provisions of Section 6 of Public Law 91-604, the Clean Air Amendments of 1970. We trust that this report will be of assistance to the Administrator of the Environmental Protection Agency in discharging his responsibilities under that Act and that it will inform the Congress of the progress which has been made, to date, toward achieving some of the goals of that Act.

The report constitutes a description, as of 1 February, of the "technological feasibility," on the part of the automobile and related industries, of achieving the automotive emissions control standards established by the Act. As the report reveals, that Act has stimulated an almost worldwide effort to develop effective emissions control systems. Of necessity, however, this report is presented at a time when the pace of developments can readily overtake categorical conclusions based on the information available today; it is, therefore, a review of the current "state-of-the-art," presented while that state is changing rapidly, and not a summary of a stabilized situation. It is for that reason, inter alia, that the report presents an analysis but offers no recommendations concerning enforcement, on schedule, of the relevant provisions of the Act.

The Committee defined "technological feasibility" to mean that an emissions control system capable of meeting the standards set for the three major pollutants can be developed, designed, produced in large numbers, and maintained in service, all at reasonable cost. By these criteria, the Committee's analysis indicates that achievement of the 1975 standards may be technologically feasible and that achievement of the 1976 standards is likely but may not be attainable on the established schedule.

However, these seemingly definitive conclusions are offered with several reservations which are held in varying degrees of gravity by individual members of the Committee. The nature of these reservations will be found in the report. They are concerned, variously, with the durability in customer use of catalyst-dependent control systems, the requirement for a network of inspection and maintenance stations, the actual likelihood of sufficiently early development of a dual-catalyst system capable of achieving the 1976 standards, and the likelihood of manufacture for Model Year 1976, on a scale commensurate with projected total national production, of a sufficient number of vehicles actually capable of meeting the 1976 standards in customer use.

The Committee is seriously concerned that the certification procedure may not prove to be an adequate indicator of the continuing reliability of catalyst-dependent, emissions control systems under the more stressful, varied conditions of consumer use. Data in this regard are not yet available, even for systems intended to meet the 1975 standards. To assure that vehicle classes certified for production actually do continue to meet the prescribed standards, the Committee considers it advisable to develop a network of inspection and maintenance stations and to train a corps of mechanics sufficient to that task. Some of the Committee, however, suggest that no more need be done than to enforce the recall provision of the Act, when so indicated by defective behavior of a reasonable sample of vehicles. It should be noted, however, that whereas that provision is binding upon the manufacturer, it is not mandatory for the vehicle owner to respond. In view of the low response to recalls for defects relating to passenger safety (30 to 50%), simple use of the recall provision under these circumstances would not suffice to meet the goals of the Act. In this regard also, it should be noted that there is not available, for such national use, a relatively simple, foolproof, reliable, diagnostic instrument for assessment of the automotive emission of the three pollutants with which the Act is concerned. It may be necessary for the Environmental Protection Agency to stimulate the research and development required to make such instrumentation available on the schedule necessitated by the Act.

The Committee found it unnecessary and inadvisable to recommend a set of interim standards for 1975 or 1976 model year vehicles. But, while contemplating its responsibility for such a recommendation, under the terms of the contract, the Committee became aware of controversies surrounding many aspects of the problem of standard setting, e.g., the nature and magnitude of the hazards to health posed by the pollutants released in automotive emissions, the relationships among the various pollutants and their ambient concentrations with respect to their health effects, the relative contributions of mobile and stationary power sources, etc. Resolution of these controversies appears imperative to long-term policy with respect to the protection of air quality. Hence, on page 127, the Committee urges that Congress and the Environmental

Protection Agency initiate a comprehensive study of these and related matters. This Academy would be pleased to be of assistance in such an effort. That recommendation should not be interpreted as taking exception to the standards established by the Clean Air Act of 1970. Most of the Committee believes that only if such an examination were to reveal compelling evidence and arguments to the contrary should the effort to achieve the emissions control standards established by the Act be relaxed; indeed, the Committee is particularly concerned that continued progress be made with respect to improvement of air quality in those urban centers where, patently, automotive emissions have contributed significantly to the deterioration of the local environment.

A major quandary which the Committee wishes to place before the Congress and the Environmental Protection Agency (page 5) arises from awareness of the relatively recent development, largely in the hands of a Japanese manufacturer, of a dual-carbureted, stratified charge engine. Although the general principle is not new, the particular design in question, incorporated into small size engines, has met the 1975 certification standards and bids fair to meet the 1976 standards. As compared with the catalyst-dependent systems now being emphasized by the major manufacturers this system offers the promise of lower initial purchase costs, greater durability in service and significantly greater fuel economy. The Committee is concerned that mass production of what are presently deemed to be relatively fragile, catalyst-dependent systems, of unproved reliability in actual service, may engender an episode of considerable national turmoil. It is further concerned that, once committed to the manufacture of catalyst-dependent control systems, rather than switch to some more generally acceptable system such as a version of the stratified charge engine that now offers great promise, the relatively ponderous automobile industry will continue to manufacture catalyst-dependent systems for some years, albeit, presumably, while also seeking more durable catalysts and mechanisms to reduce the severe fuel penalty of current catalyst-dependent systems with their associated mechanical features. The dilemma, then, is to determine what course of action, by government, would assure the earliest possible optimal outcome while scrupulously avoiding dictation, by government, of the technology to be used. The Committee offers no recommendations in this regard.

Relevant to this situation are the costs, per vehicle, associated with the initial purchase, maintenance and operation (including the effects on fuel consumption) of the various emissions control systems under consideration. The annualized incremental costs, viz., the cost per car/year for a standard engine, relative to a 1970 standard engine, due to the emission control system, for operation and maintenance of the vehicle with the purchase cost of the system amortized over the first five years of operation, were found, by the Committee to be as follows: 1973 engine, about $100; single catalyst system (1975 standards), about $225; dual catalyst system (1976 standards), about $270; and the dual-carbureted stratified charge engine , about $70. The high annualized costs of the catalyst systems reflect the serious associated fuel penalties.

For the nation, these costs represent a concrete example of the principle that the costs of environmental protection can be met only if they are internalized. The magnitude of this process derives from the great numbers involved, viz., about 10^7 (10 million) vehicles produced per year and almost 10^8 (100 million) registered automobiles. Thus, a one-year production of 10^7 vehicles equipped with the presently proposed dual-catalyst system would result in additional expenditures -- as compared with 1970 automobiles -- of $2.7 billion per year for each of the first five years of the life of that model year of cars, assuming constant fuel prices, and about $2 billion per year thereafter.

In due course, all vehicles will be equipped with emission controls capable of meeting the 1976 standards. Were all (10^8) cars equipped with the dual-catalyst system, at current costs this would result in a national annual total expenditure for emissions control of the order of $23.5 billion (assuming a mean life of ten years/car with purchase cost amortized over the first five years, and current fuel prices).

Such figures are to be taken as no more than an indication of their orders of magnitude. The increased sticker price would tend to cause consumers to buy smaller cars of greater fuel economy and the fuel penalty would tend to reduce mileage. The initial costs will probably decline as dual-catalyst systems and their manufacture are improved. On the other hand these gains could be offset by the foreseeable rise in fuel prices. Unless satisfactory feedback control and fuel injection systems, for catalyst-dependent systems with the associated mechanical features, become available, the total costs will be dominated by the fuel penalty associated with such systems. These costs, in dollars and in depletion of fuel reserves, are so great that they should serve as a national incentive to hasten the development of reliable lower-cost alternatives to the dual-catalyst system as a solution to the problem of emissions control.

In contrast, several of the promising alternatives, such as the carbureted stratified-charge engine, carry with them costs of the order of those already associated with the 1973 engine, viz., an annualized cost for emissions control of about $100/car during the first five years of service, for an annualized total of perhaps $7.5 billion for the full fleet of 10^8 cars.

Costs of these magnitudes suggest, of themselves, the need for attention to a series of considerations which lie outside the scope of the present report. Among such questions are: What is the effect of this enterprise on the GNP? Is it, in effect, a stimulus to the overall economy or are the funds utilized to defray these expenditures removed from alternate uses in the economy, e.g., for improvement in the health care delivery system? If the answer to the latter is affirmative in significant measure, is this the wisest use of such funds for protection of the public health? What effects would large-scale employment of the most promising emissions control systems have on the international balance of payments? If emissions control can only be satisfactorily accomplished by acceptance of a large fuel penalty, e.g., the dual-catalyst system or the Wankel engine with thermal reactor, what judgment should be made under such circumstances? Should it turn out that noble metal catalysts are more effective and, seemingly, economic than other catalysts, how should one weigh this raid on the very limited supply of this resource in the skin of the planet?

Whereas pollutant emission is undesirable anywhere, emission control does not appear, today, to be essential on the basis of either essentially aesthetic or health considerations in large areas of the nation. Indeed, overall, natural production of hydrocarbons, carbon monoxide and perhaps NO_x far exceeds that from man-made sources. In view of the costs to the nation, in dollars and in fuel consumption, of early implementation of the 1975-76 standards, attention seems warranted to the possibility of temporarily enforcing the established emissions standards only in those specific urban areas where air quality is known to be adversely affected by automotive emissions, reserving national implementation for the day when there are available reliable, relatively inexpensive emissions control systems which exact no fuel penalty.

Emissions control is but one aspect of "the problem of the automobile" in our society. This device has given Americans an 'automobility' unknown in previous human history, enriched the personal experience of each of us, broadened our horizons and helped to make the large expanse of American geography into one nation. But this aspect of our society has begun to be defeated by its very success.

The automobile has also accelerated depletion of several critical natural resources, including the petroleum which fuels it. It has scarred the land and choked the city, contributing seriously to deterioration of the quality of urban life. In the long run, the truly effective mechanisms for emission control must include a significant reduction in the number of cars operated in the city, a solution dependent upon acceptable, public mass transit systems, and a substantial reduction in the mean size (weight, volume, and horsepower) of those automobiles which do function in the city, as well as, perhaps, redistribution of the pattern of physical relationships among dwelling and working areas. Patently, these are relatively long-term goals, achievement of which will require extensive, meticulous study and planning with subsequent large public expenditures and careful public intervention into the behavior of the private sector.

For the short term, however, automotive emissions control can be accomplished by a relatively simpler, technological "quick fix," and, perhaps, on the schedule established by the Clean Air Amendments of 1970. The attached report summarizes the status of the alternatives currently offered as means whereby to achieve the earliest acceptable technological solution to this problem.

Respectfully yours,

Philip Handler
President

NATIONAL RESEARCH COUNCIL

NATIONAL ACADEMY OF SCIENCES NATIONAL ACADEMY OF ENGINEERING

2101 CONSTITUTION AVENUE WASHINGTON, D.C. 20418

COMMITTEE ON MOTOR VEHICLE EMISSIONS
OF THE DIVISION OF ENGINEERING

TELEPHONE: 202-961-1621

February 12, 1973

Dr. Philip Handler
President
National Academy of Sciences
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

Dear President Handler:

I am herewith transmitting for submission by the Academy to the Congress and to the Environmental Protection Agency the Report of the Committee on Motor Vehicle Emissions dated February 12, 1973.

Sincerely yours,

E. L. Ginzton
Chairman

Report

by the

COMMITTEE ON MOTOR VEHICLE EMISSIONS

Division of Engineering, National Research Council
in accordance with Section 202(c) of the
Clean Air Amendments of 1970 and
in partial fulfillment of Contract No. 68-01-0402

between

THE ENVIRONMENTAL PROTECTION AGENCY

and

THE NATIONAL ACADEMY OF SCIENCES

National Academy of Sciences
Washington, D. C.

February 12, 1973

NOTICE

The study reported herein was undertaken under the aegis of the National Academy of Sciences and with the express approval of the Governing Board of the National Research Council. Such approval indicated that the Board considered that the problem is of national significance; that elucidation and/or solution of the problem required scientific and technical competence and that the resources of the National Research Council were particularly suitable to the conduct of the project.

The members of the committee were selected for their individual scholarly and technical competence and judgment with due consideration for the balance and breadth of disciplines. Responsibility for the detailed aspects of this report rests with the committee, to whom we express our sincere appreciation.

Reports of our study committees are not submitted for approval to the Academy membership. The report was reviewed by a panel of Academy members according to procedures established and monitored by the Academy's Report Review Committee. Such reviews are intended to determine, inter alia, whether the major questions and relevant points of view have been addressed and whether the reported findings, conclusions and recommendations arose from the available data and information. Distribution of the report was approved, by the President, only after completion of this review process.

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APPENDIXES

TABLES

TABLES (Continued)

FIGURES

SUMMARY AND CONCLUSIONS

In legislating the Clean Air Amendments of 1970, the Congress asked the Environmental Protection Agency (EPA) to contract with the National Academy of Sciences (NAS) to conduct a comprehensive study and investigation of the technological feasibility of meeting the motor vehicle emissions standards prescribed in accordance with the law. In responding to this request, pursuant to a contract with the EPA, the Academy established a Committee on Motor Vehicle Emissions (CMVE) and charged it with the conduct of this study.

In its investigation of "technological feasibility," the CMVE addressed the following issues:

1. Determination of the feasibility of developing and designing an emissions control system that would enable compliance with the legally established emissions standards as judged by the certification procedures prescribed by the EPA.

2. The feasibility of mass producing those systems of promising design.

3. The projected performance of such emissions control systems in customer usage, including the requirements for maintenance necessary to assure continuing reliability.

4. The costs, per vehicle, associated with acquisition, maintenance, and operation of the emissions control system.

In the course of its work, the Committee has examined the variety of approaches of manufacturers and others to the problems relating to emissions control. At the time of this report, progress toward resolution of these problems in the four aspects listed above, although rapid, is uneven and uncertain, and the outlook toward 1975 and 1976 is not yet clear. Moreover, the rapid pace of that progress complicates judgment concerning the most appropriate course of action for attainment of the standards required by the law.

For 1975 model year light-duty motor vehicles, the Committee concludes that --

1. Four types of systems will meet the prescribed emissions standards during certification testing. These are: the modified conventional engine equipped with an oxidation catalyst, the carbureted stratified-charge engine, the Wankel engine equipped with an exhaust thermal reactor, and the diesel engine. For the catalyst system, one catalyst change must be permitted during the 50,000 mile durability testing for certification, and fuel with a suitably low level of catalyst poisons must be allowed. In determining whether vehicles mass-produced comply with an outstanding certificate of conformity under Section 206 of the Clean Air Act, provisions must be made for averaging of emission test results within a vehicle and engine class.

2. Vehicles incorporating these systems can be mass-produced in great enough volume to satisfy, in aggregate, the expected demand for vehicles in model year 1975.

3. It is important for two reasons that a suitable maintenance and inspection system be established for vehicles in use by the public.

First, there are no data concerning the deterioration of emission-control systems under conditions of customer use, and the Committee believes that the certification procedure alone is not a sufficient indicator of system durability. Even if it is demonstrated that properly maintained vehicles can comply with the standards under conditions of customer use, an adequate vehicle maintenance and inspection system will be required to assure that most vehicles will meet the standards when used by the general public; this is especially important for catalyst-equipped vehicles.

Second, if it is determined that a substantial number of any class of vehicles or engines, although properly maintained and used, is not meeting the standards in use, Section 207(c) of the Clean Air Amedments empowers the Administrator of EPA to require the manufacturer to submit a plan for remedying the nonconformity. Under such a plan, the manufacturer is required to correct only those vehicles or engines which have been properly maintained and used.

4. The average increase in sticker price due to the emissions-control system of a catalyst-equipped vehicle is estimated to be \$160 above a current (1973) vehicle and \$230 above a 1970 model year vehicle. Except for the diesel engine, lesser increases are expected for the other emission-control systems, when comparing vehicles of similar size and type.

Model year 1975 vehicles using Wankel engines or catalyst-equipped spark-ignition piston engines will use significantly more fuel than their 1973 counterparts. Carbureted stratified-charge engines will suffer only a slight fuel penalty; and the diesel engine will offer improved fuel economy, enough to compensate for its high initial cost within a few years of driving.

For 1976 model year light-duty motor vehicles, the Committee concludes that --

1. Five control systems now in early stages of development have met the 1976 emission standards at low mileage. These are: the modified conventional engine equipped with dual catalysts, or with dual catalysts plus thermal reactor, or with two thermal reactors and a reduction catalyst, or with a three-way catalyst and electronic fuel injection, and the stratified-charge engine employing fuel injection and equipped with an oxidation catalyst. It is possible, but not certain, that some of these systems may prove to be certifiable for 1976, contingent upon the acceptance of the same provisos previously mentioned for 1975 model year vehicles.

   More importantly, the recently developed carbureted stratified-charge engine, after 50,000 miles of durability testing on a compact car, has achieved well over the 90 percent reduction in hydrocarbon and carbon monoxide emissions called for in the Act and about 83 percent reduction in NO_x. The Committee believes that this engine will be certifiable for 1976, at least in smaller engine sizes.

2. If certifiable, vehicles incorporating any of these systems can be mass-produced, but not necessarily in great enough volume to satisfy, in aggregate, the expected demand for vehicles in model year 1976.

3. The Committee holds the same concerns for performance of 1976 vehicles in use as discussed above for 1975 systems.

4. The average increase in sticker price of a dual-catalyst-equipped vehicle is expected to be $290 above a current (1973) vehicle, and $370 above a 1970 model year vehicle. Average annual costs of a dual-catalyst emissions-control system, including maintenance and fuel, with the increase in sticker price amortized over five years, is estimated to be $260 per year, compared with a 1970 model year vehicle. In contrast, the annualized costs for several other systems are estimated to be less than $100.

The Committee is greatly concerned about the trend of development of the 1976 control systems. The system most likely to be available in 1976 in the greatest numbers - the dual-catalyst system - is the most disadvantageous with respect to first cost, fuel economy, maintainability, and durability. On the other hand, the most promising system - the carbureted stratified-charge engine - which may not be available in very large numbers in 1976, is superior in all these categories. The Committee wishes to alert both EPA and the Congress to this development and believes that it warrants immediate attention.

1. INTRODUCTION

The Clean Air Amendments of 1970, which established exhaust emission standards for 1975 and 1976 light-duty vehicles (henceforth called vehicles) and light-duty vehicle engines, called on the Administrator of the Environmental Protection Agency (EPA) "to enter into appropriate arrangements with the National Academy of Sciences (NAS) to conduct a comprehensive study and investigation of the technological feasibility of meeting the emission standards" promulgated by the Clean Air Amendments. Meetings held between the NAS and EPA early in 1971 resulted in the establishment of a mutually agreeable work statement for the Committee on Motor Vehicle Emissiona of the National Academy of Sciences. An extract from the work statement follows:

<u>Statement of Work</u>

A. The Contractor shall conduct a many-faceted study of the technological feasibility of meeting the motor vehicle emission standards prescribed by the Administrator of the Environmental Protection Agency, as required by Section 202(b) of the Clean Air Act, as amended.

B. For the purposes of this study the term "technological feasibility" includes the ability within the automobile industry or elsewhere to

1. Design an engine, control system, or device capable of meeting the statutory emission standards using fuels which are or could be available

2. Mass produce such an engine, control system, or device

3. Maintain such an engine, control system, or device so that it will continue to meet the statutory emission standards with safety for a period of five years or 50,000 miles of operation, whichever is shorter.

C. The study of technological feasibility as defined shall include a study emphasizing the technical aspects of the reported costs expected to be incurred in and the estimated time for the design, development, and mass production of an engine, control system, or device capable of meeting the statutory emission standards.

D. The study of technological feasibility shall include a study emphasizing the technical aspects of the reported estimates of extra cost incurred in maintaining such an engine, control system, or device so that it will meet the statutory emission standards for a period of five years or 50,000 miles, whichever is shorter.

E. Should the Contractor conclude that the attainment of emission standards on the schedule provided by Section 202(b)(1) of the Clean Air Act is not technologically feasible, the Contractor shall specifically determine technologically feasible interim emission levels to assist the Administrator in exercising his responsibilities under Section 202(b)(5) of the Act.

1.1 Past Work of the Committee on Motor Vehicle Emissions

Membership of the Committee, shown in Appendix A, was selected entirely by the National Academy of Sciences.

The first meeting of the Committee took place on June 16, 1971, with subsequent meetings held approximately once each month. The Clean Air Amendments called for the Committee to submit semiannual progress reports to the Administrator and to Congress. One of the primary functions of such reports was to provide advice to the Administrator of EPA with respect to his decision whether or not to postpone for one year the applicable deadlines of the standards called for by the Clean Air Amendments. Under the legislation, anytime after January 1, 1972, any manufacturer may file with the Administrator an application requesting a one year suspension of the regulations applicable to emissions from 1975 model year vehicles. Anytime after January 1, 1973, any manufacturer may file an application requesting a one year suspension of the regulations applicable to emissions from 1976 model year vehicles.

The Administrator must make his determination of each request for suspension within 60 days.

To provide maximum assistance to the Administrator in the formulation of his decision, and with due consideration of the timing required for such a decision, the Committee issued its first substantive report on January 1, 1972, containing a comprehensive study of the technological feasibility of the standards applicable to 1975 model year vehicles. In April 1972, in response to a direct request from EPA, the Committee prepared a report with respect to possible interim standards, in the event the Administrator were to grant a suspension of the 1975 standards. A brief progress report was submitted July 1, 1972, discussing the various areas of investigation of the Committee at that time.

This report of the Committee emphasizes the question of technological feasibility of the 1976 standards. In August 1972, the Administrator denied the requests of Volvo, International Harvester, Chrysler, Ford, and General Motors for a suspension of the 1975 standards. Requests for suspension of the 1975 standards may, however, be filed again by the above manufacturers or by others. A portion of this report is thus addressed to the technological feasibility of the 1975 standards.

1.2 Panels of Consultants

The Committee has recognized the importance of having available to it the most recent and complete technical data and information upon which to make its judgments. Much of the information has been provided by eight panels of consultants, each panel dealing with a particular subject area of importance in the Committee deliberations. Panel members were selected by the Committee on the basis of recognized competence in specific areas. Membership of the panels is shown in Appendix B. Seven of these panels were in operation during 1971. The Catalyst Panel was added early in 1972 after the Committee became aware of the many controversial and critical factors associated with the operational characteristics of the automotive catalyst. The work of each of the panels was as follows.

1.2.1 Testing, Inspection, and Maintenance

The Panel on Testing, Inspection, and Maintenance was organized to assess the feasibility of ensuring that automobiles manufactured for 1975-1976 model years continue to meet the specified emission standards in actual customer use over the required period. The panel evaluated each method as a system, from certification testing through assembly-line control, surveillance, inspection, and maintenance in use. This study also considered the necessary training and licensing of mechanics, enforcement action required, short emission tests suitable for inspection or diagnosis, surveillance testing, feasibility of required maintenance procedures, and costs of maintaining emission-control systems for 1975-1976 vehicles.

1.2.2 Emission-Control Systems

The Panel on Emission-Control Systems was to investigate the potential of experimental 1975-1976 emission-control systems, including consideration of the durability of these systems. The activities of this panel were restricted to studies of emission control for the spark-ignition internal-combustion engine including the Wankel and stratified-charge types of engines. The use of different fuels, such as liquefied petroleum gas (LPG), as well as dual-fuel concepts were also evaluated.

1.2.3 Alternate Power Sources

This panel was responsible for evaluating all automobile power source concepts except the conventional Otto-cycle engine, the internal-combustion Wankel engine, and the stratified-charge engine. The panel thus considered diesel engines, Rankine-cycle engines, Brayton-cycle engines, Stirling engines, electric systems, hybrid systems, and several systems that fell into no broad category.

The panel was to determine if it would be possible for any of the candidate engine systems to meet the 1975-1976 emission standards in production and the 50,000-mile (or five-year) life standard. For each promising system, the panel estimated the earliest possible date that mass production could be achieved. Major technical problem areas were identified for each system, and the probability of solving these problems was estimated.

Acceptability of each system, to the customer and to the industry, was predicted by the panel on the basis of driveability, safety, starting characteristics, maintainability, noise, cost, fuel economy, and many other factors. Some of these determinations were made in cooperation with other panels.

1.2.4 Manufacturing and Producibility

This panel was concerned with the manufacturability of low-emission systems and their components. The effort was not limited to the technical possibility of building one or a few systems; the technological feasibility of producing millions of systems in 1975 and 1976 was determined. This study included such considerations as producibility, tooling, lead time, and costs.

The work of this panel was directed toward helping the Committee determine, as specified in paragraph B2 of the Statement of Work, whether, within the automobile industry or elsewhere, there was a capability to mass-produce an engine, control system, or device capable of meeting the emission standards.

1.2.5 Driveability

The mission of this panel was to appraise the driveability of vehicles powered by candidate engine systems. Good driveability is loosely defined as the ability of a vehicle to start, operate, and stop smoothly under all environmental and operating conditions, without stalls, surges, hesitations, after-firing, and other undesirable characteristics.

There has been considerable testimony expressing opinions that some of the emission-control systems, especially if not properly maintained, would seriously affect the safety of the car, not only relative to its occupants, but also relative to other vehicles in traffic. Thus, assessing driveability is an important aspect of determining the feasibility of using a given system or engine. The work of this panel was done in conjunction with that of the Panel on Emission-Control Systems.

1.2.6 Catalysts

The CMVE organized this panel when it became apparent that the durability of many proposed emission-control systems is closely tied to catalyst performance. This panel analyzed activity and durability of both oxidation and reduction catalysts for emission-control systems. The major causes of catalyst failure during vehicle operation were examined. The effect on catalyst deterioration of the level of poisons in gasoline such as lead, sulfur, and phosphorus was studied, as was the effect of over-temperature on catalyst activity. Availability of catalytic materials and possible toxicity problems associated with the use of certain catalysts were also investigated.

1.2.7 Emission Standards and Atmospheric Chemistry

The work of the Panels on Emission Standards and Atmospheric Chemistry was associated with the requirement in the original work statement concerning recommendation by the Academy of technologically feasible interim emission levels.

The major concern was with interim levels for the 1976 standards, in the event that achievement of such standards was to be delayed a year. For the 1976 standards, oxides of nitrogen (NO_x) must be controlled in addition to hydrocarbons (HC) and carbon monoxide (CO); procedures that reduce NO_x do not necessarily reduce HC and CO, and may increase them. There are many sets of technologically feasible levels of the three pollutants that the Committee might recommend. Thus, these two panels have studied the various possibilities and tradeoffs.

The Panel on Atmospheric Chemistry determined, from the latest available data, the relationship between ambient concentrations of HC and NO_x necessary to cause undesirable levels of oxidant production. The Panel on Emission Standards used these data, along with desirable air-quality goals for CO and NO_x, and developed corresponding motor vehicle emission levels.

Each of the panels has devoted considerable time and effort to the work of the Committee. Some of the panel members have given virtually full-time effort to Committee work. These panels have traveled extensively and probed deeply in their attempts to bring before the Committee the material and information needed for the Committee to reach the judgments called for in the legislation. Panel visits have been made to domestic and foreign automobile manufacturers, to domestic and foreign catalyst suppliers, to the EPA and other government laboratories, to independent research laboratories, to state and local agencies concerned with the problems of enforcing emission standards, to those carrying out research and development on many types of alternate power plants, to oil companies, and to many others. A list of companies and individuals visited or otherwise contacted by CMVE personnel is given in Appendix C.

In each visit, panel members have endeavored to ensure the timeliness and validity of the data furnished to them. Panel visits have involved discussions with personnel ranging from top management to working technicians and engineers.

The panels have reported periodically to the parent Committee on their progress. Close contact has been maintained between the panels and the Committee, to ensure that the panels were stressing the necessary topical areas in their investigations. Panel activities terminated with the submission of final written panel reports to the Committee.

1.3 Other Means of Obtaining Information

The Committee has attempted to solicit pertinent information from the general public. Announcements have been placed in the Federal Register requesting information with respect to technological feasibility. Descriptions of these announcements are included as Appendix D.

Finally, the Committee as a whole visited General Motors and Ford in Detroit on May 18 and 19, 1972, to get a first-hand view of the efforts of two of the larger manufacturers toward meeting the emission standards. Visits by selected members of the Committee were made to other manufacturers.

The judgments of the Committee to be presented in this report necessarily rely upon the information received using the various sources mentioned above. The Committee believes that it has had presented to it sufficient information upon which to base its judgments.

NOTE

Final reports of the CMVE panels are being prepared as technical publications and will be made available to the public by the National Research Council. Other pertinent information will be maintained as a public record in the files of the CMVE.

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2. THE STANDARDS, CERTIFICATION AND TESTING

2.1 Numerical Values of Standards

Section 202 of the Clean Air Amendments of 1970 requires the Administrator of the EPA to prescribe emission standards for light-duty motor vehicles together with measurement techniques on which such standards are to be based.* Such standards require that the emissions of carbon monoxide and unburned hydrocarbons from light-duty vehicles and engines manufactured during or after model year 1975 be reduced by at least 90 percent from these required of 1970 vehicles; also, emissions of oxides of nitrogen from light-duty motor vehicles and engines manufactured during or after model year 1976 are to be at least 90 percent below the average of those actually measured from light-duty vehicles manufactured during model year 1971 which are not subject to any federal or state emission standards. The 1975 model year standards are:

0.41 grams per vehicle mile for hydrocarbons (HC)
3.4 grams per vehicle mile for carbon monoxide (CO)
and 3.1 grams per vehicle mile for oxides of nitrogen (NO_x).

Standards for 1976 model year vehicles are:

0.41 grams per vehicle mile for hydrocarbons
3.4 grams per vehicle mile for carbon monoxide
and 0.4 grams per vehicle mile for oxides of nitrogen.

The Clean Air Amendments call for vehicle compliance with the above standards for five years or 50,000 miles, whichever occurs first.

2.2 Procedures for Certification, CVS-CH Test

The numerical values of the standards must be defined in terms of a specific method of measurement and a specific driving cycle. The EPA Administrator is required by Section 206 to test any motor vehicle

*The Federal Register of November 15, 1972, contains a complete description of the regulations concerning the standards, test procedures, allowable maintenance, etc.

or class of motor vehicles to determine whether they meet the standards set forth in Section 202(b) of the Clean Air Amendments. A certificate of conformity is to be issued for classes of motor vehicles that comply with the standards, thus permitting the manufacture and sale of these classes of vehicles. The emissions test to be used for certification of 1975 and 1976 vehicles, referred to as the CVS-CH test, consists of a 12-hour wait at a temperature between 60° and $86^{\circ}F$, a cold-engine startup, a continuous sequence of different driving modes simulating an average trip over a 23-minute route in an urban area, a ten-minute shutdown followed by a hot-engine restart, and a repeat of the first 505 seconds of the 23-minute cycle. This test is performed with the vehicle on a chassis dynamometer. Exhaust-gas sampling begins immediately after the key is turned on (whether the engine starts or not). Diluted exhaust emissions are collected during the first 505 seconds in one bag, those during the remainder of the 23-minute cycle in a second bag, and those from the hot-restart phase in a third bag. Contents of the three bags are then analyzed and weighted in accordance with the EPA test procedure to get the final mass emissions, in grams per mile, of HC, CO, and NO_x.

To obtain a certificate of conformity for a class of vehicles, the automobile manufacturer must also demonstrate the effectiveness of the vehicles' emission-control system over the "useful life" of a vehicle. The regulations require a manufacturer to test two separate fleets of prototype vehicles representing models to be sold to the public. The "emission data" fleet is intended to determine the emissions of relatively new vehicles. The vehicles in this fleet are driven 4,000 miles to break in the engine and stabilize emissions. The emissions are then measured, using the CVS-CH test procedure. Allowable maintenance on emission-data vehicles is limited to the adjustment of engine idle speed at the 4,000-mile test point.

The second fleet, the "durability-data" fleet, is designed to determine the capability of the emission-control system to keep emissions below the standards over the expected useful life of the vehicle. The vehicles in this fleet are driven for 50,000 miles and tested for emissions every 4,000 miles. The procedure for mileage accumulation is the Durability Driving Schedule over a modified AMA route. The maximum speed is 70 mph, and the average is 30 mph. One major engine tuneup to manufacturer's specifications may be performed on durability vehicles at 24,000 miles (on vehicles with 150-CID or less, at 12,000, 24,000, and 36,000 miles). The replacements and adjustments allowed are detailed in the regulations. Emissions tests must be run before and after any vehicle maintenance that may be reasonably expected to affect emissions. As the first step in determining compliance of a new light-duty vehicle, emission-deterioration factors are determined from the durability-data fleet emission test results. Separate factors are determined for HC, CO, and NO_x and for each engine/control-system combination. A straight line is fitted, by the method of least squares, to each of the plots of emissions versus mileage for the endurance fleet. For each of the three pollutants, deterioration factors are determined from these curves as the ratio of emissions at 50,000 miles to those at 4,000 miles. The emission test results, at 4,000 miles, for each emission-data fleet vehicle are then multiplied by the appropriate deterioration factor to give adjusted emissions for each vehicle. These adjusted emissions are then compared to the standards. Every test vehicle from an engine family must comply with the standards before any vehicle in that family can be certified.

2.3 Production-Line Testing

To ascertain whether vehicles are being manufactured in accordance with the regulations with respect to which a certificate of conformity was issued, Section 206(b) authorizes EPA to test new vehicles and engines. Such tests can be conducted by EPA or by the manufacturer in accordance with conditions specified by EPA. According to Section 206(b)(2)(A), if:

> "based on tests ... on a sample of new vehicles or engines covered by a certificate of conformity, the Administrator determines that all or part of the vehicles or engines so covered do not conform with the regulations with respect to which the certificate of conformity was issued, he may suspend or revoke such certificate in whole or in part ..."

The Act sets forth a procedure for reissuance of the certificate and for hearings on its suspension or revocation.

It is impractical to determine the emissions from a large fraction of production vehicles by the CVS-CH procedure. Each test involves a twelve-hour wait at room temperature followed by a 41-minute test, with expensive and complex instrumentation required. In addition, measurements of exhaust emissions show poor repeatability. Data from the automobile manufacturers and several independent laboratories taken on 1972 model year vehicles using the 1975 Federal CVS-CH test show coefficients of variation of 10 to 20 percent. When the CVS-CH test is applied to 1975-76 prototype vehicles, the probable percentage error increases, since emission levels have decreased from 1972. Only limited data were available of test reproducibility using the CVS-CH test with dual-catalyst-equipped vehicles near the 1976 emission levels. Coefficients of variation for these limited data, consisting of 16 repetitive tests on a vehicle, were as great as 50 percent for CO. Test on three-valve carbureted stratified-charge engines, which meet 1975 standards, have yielded much lower coefficients of variation.

Some of the reasons for the lack of repeatability of measurements are the difficulty of following the speed-time curve specified in the CVS-CH procedure, lack of repeatability of some of the engine functions having an effect on emission control (such as the choke time), and the fact that the 1975-76 pollutant levels give such low concentrations in the sample bags that the resolution capabilities of the instruments are approached. The variation of test results during the cold portion of the test is the largest part of total test variation, with a large percentage of CO and HC emissions occurring during the first two minutes of the CVS-CH test. An individual measurement using the CVS-CH test on a 1975-76 car can vary from the true value by 50 percent and thus little significance should be attached to a single test. Since a hot-start test does not include the emissions that dominate the results obtained with the CVS-CH test, no short hot-start test will pass and fail exactly the same vehicles as the CVS-CH test. It thus is evident that 100 percent production-line testing with any procedure except CVS-CH test (impractical on production line) cannot determine if all vehicles are being manufactured in accordance with the regulations with respect to which a certificate of conformity was issued.

In terms of overall air quality, it is the average emissions from a group of cars that determines the automotive contribution to air pollution. This fact and the variability of test results mentioned above shows a need for regulations that control the manufacture and operation of vehicles to ensure that the emissions on the average meet the standards. It is only necessary to test a quality audit sample of production-line vehicles to demonstrate that the average emissions of production vehicles compare satisfactorily with the certification standard, taking into account a prescribed useful life deterioration factor and a tolerance factor reflecting the difference between production vehicles and pre-production prototypes. The logical test to choose for this quality audit is the CVS-CH procedure.

The Committee recommends, as in the CMVE January 1, 1972 report, that only the emissions of the average of each engine-vehicle combination on the production line be required to meet the standards. A requirement that all vehicles meet the emission standards is too restrictive and is unnecessary to meet air quality needs.

2.4 Compliance after Sale, Warranty

The recommendation covering production-line averaging has an impact on the warranty provisions of the law, contained in Sections 207(a) and (b) of the Clean Air Amendments. Section 207(a) requires that the manufacturer of each new motor vehicle and engine shall warrant to the purchaser that it is (1) designed, built, and equipped so as to conform at the time of sale with (the applicable standards), and (2) free from defects in materials and workmanship which cause such vehicle or engine to fail to conform with (the standards) for its "useful life."

Section 207(b) deals with warranties for vehicles throughout their useful life. This section states that manufacturers could ultimately be required to warrant compliance of the emission control system of a vehicle throughout its useful life if it is maintained and operated in accordance with the manufacturer's instructions and if the nonconformity results in the car owner "having to bear any penalty or other sanction . . . under State or Federal law." Before such a useful-life warranty can be imposed however, the Administrator must first determine that there are available testing methods and procedures to ascertain whether a vehicle, when in actual use, complies with the emission standards and that such methods and procedures are reasonably capable of being correlated with tests conducted by EPA preparatory to issuance of a certificate of conformity (meaning the full CVS-CH procedure). These warranty provisions apply to each vehicle. However, if it is concluded that there is no short test or procedure that reasonably correlates with the CVS-CH test, the problem of possible conflict in implementing the warranty requirement is eliminated. After consideration of this point, the Committee concludes that no short test is available now, or likely to be available in the near future, that will pass and fail the same vehicles as the full CVS-CH test.

Section 207(c) of the Clean Air Act deals specifically with recall of vehicles which, although properly maintained, do not conform with the standards. According to Section 207(c)(1), "If the Administrator determines that a substantial number of any class or category of vehicles or engines, although properly maintained and used, do not conform to the regulations prescribed under Section 202, when in actual use throughout their useful life (as determined under Section 202(d)), he shall immediately notify the manufacturer thereof of such nonconformity, and he shall require the manufacturer to submit a plan for remedying the nonconformity of the vehicles or engines with respect to which such notification is given."

Since the purpose of the Clean Air Amendments is to control the automotive contribution to air pollution, the Committee believes that a surveillance audit of a statistical sample of vehicles is adequate to determine if each family of cars meets the standards. The full CVS-CH test would be run for the surveillance audit. Such surveillance tests could be used not only to determine emissions from each car family, but also to evaluate deterioration of emission control systems in actual use, to evaluate the effectiveness of prescribed maintenance procedures, to develop information on failure modes, and to establish the need for recall of a class of vehicles.

3. POTENTIAL OF SPARK-IGNITION INTERNAL-COMBUSTION ENGINES PASSING EMISSION CERTIFICATION FOR 1975 and 1976

3.1 Introduction

The investigations of the Committee to date have shown that, according to current planning of the automobile manufacturers, the great majority of the engines to be used in 1975-76 model year vehicles will be conventional, reciprocating, spark-ignition engines. A smaller fraction of the 1975-76 vehicles will use Wankel rotary engines, and one manufacturer (Honda) has plans to produce a new type of carbureted stratified-charge engine. Some passenger-car diesel engines will still be produced, but these will differ only slightly from the diesel engines currently available. Diesel engines are discussed more fully in Section 6.1.

This section of the report will present an analysis and evaluation of the prospects of spark-ignition engines passing the emissions certification test for 1975 and 1976 model year vehicles.

3.2 Current Status of 1975 Systems

The January 1, 1972, report of the CMVE dealt at considerable length with the technological feasibility of meeting the 1975 standards. At the present time, most automobile manufacturers have developed somewhat similar prototype emission-control systems for their 1975 model year vehicles. The major U. S. and foreign manufacturers are currently assembling and testing fleets of vehicles equipped with the complete system to evaluate different promising catalyst materials and to obtain data on system durability before final production designs are frozen.

These 1975 emission-control systems typically consist of:

(i) An improved carburetor to provide more accurate fuel metering, with compensation for air-density changes, and with an electrically powered choke that comes off quickly at ambient temperatures of about 70°F.

(ii) A quick-heat intake manifold designed to promote rapid fuel evaporation after engine start-up.

(iii) An electronic ignition system to eliminate the wear and other problems of current distributor assemblies and to allow easier spark-timing control. (Inadequate maintenance of present distributors commonly results in increased engine emissions.)

(iv) An exhaust-gas recycle (EGR) line and control valve designed to recycle about 10 percent of the exhaust flow to hold NO_x emissions below 3 grams per mile (g/mile).

(v) An air pump to inject air into the exhaust ports to oxidize carbon monoxide and hydrocarbons.

(vi) A catalytic converter in the exhaust system to promote further oxidation of the HC and CO emissions from the engine.

For some manufacturers, the current fleet tests represent the first extensive evaluation of the complete engine emission controls with the best oxidation catalyst materials now available. Data obtained from some of these manufacturers' fleets are shown in Table 3-1. (Most of the data in Section 3 of this report were received in reply to a questionnaire dated July 13, 1972 or were presented during recent panel visits.) These tests follow the durability driving cycle and maintenance procedures used in the emissions certification of vehicles.

Progress in emission control for 1975 systems using catalytic converters has been made since the CMVE report of January 1, 1972. It is highly probable that most manufacturers will be able to produce vehicles that will pass the 1975 certification test procedure, providing

Emissions Performance of Major Manufacturers 1975 Model Year Development Fleets

Manufacturer	Vehicle Weight Range, lbs.	Engine Size Range, CID	No. of Vehicles	Mileage	Emissions in gms/mile[a] HC	CO	NO_x
Ford[b]	4000 - 5000	250 - 460	8	4000	0.46	3.2	2.7
			7	36000	0.73	5.2	2.2
Ford[c]	4000 - 5000	250 - 460	6	4000	0.34	3.3	2.2
			5	36000	0.40	2.6	2.4
General Motors[b]	2750 - 5500	140 - 550	30	4000	0.34	2.3	2.0
			17	12000	0.42	2.6	2.0
			7	24000	0.39	2.2	1.8
Nissan[b]	2750	98	5	4000	0.29	1.8	1.0
			5	16000	0.50	2.2	0.95
			1	24500	0.48	3.8	0.95
Toyota[d]	2500	97	6	4000	0.35	2.9	1.4
			4	12000	0.52	5.5	2.1
			3	24000	0.66	9.0	1.2

Notes

a - 1975 CVS-CH test procedure. Durability driving schedule, maintenance, and fuel used approximate those anticipated in 1975 certification procedure. Emissions averaged over all vehicles tested at that mileage. No catalyst replacements were made during any of these tests.

b - Emission control system: engine modifications, air pump, oxidation catalyst, EGR.

c - Emission control system: engine modifications, air pump, 2 oxidation catalysts; EGR.

d - Emission control system: engine modifications, manifold reactor, air pump, oxidation catalyst, EGR.

allowance is made for one catalyst replacement during the 50,000-mile durability tests, that fuel containing sufficiently low levels of lead and other catalyst poisons is used, and that averaging of emissions within automobile and engine classes is allowed.

Emission-control systems are also being developed that do not use catalysts and therefore have improved durability over the catalytic systems. The three-valve stratified-charge carbureted engine, under development by Honda, has achieved emissions below the 1975 standards at low mileage on compact cars (for details, see Section 3.9.2). Three vehicles equipped with a 2-liter engine (122 CID) have completed 50,000-mile durability testing and met the standards at every test throughout the test period.

The Wankel engine with a thermal reactor has achieved emission levels below the 1975 standards in a compact car. This system has already demonstrated improved durability over a catalytic system. Data from the few cars tested over extended mileage indicate that deterioration will be relatively low.

3.3 Engine Emissions for 1976 Systems

3.3.1 Introduction

In developing systems to meet the 1975 standards, most automobile manufacturers have emphasized that such systems must be compatible with 1976 requirements. There has thus been a concentration on 1975 control systems that can be modified to achieve the greater NO_x emission control called for in 1976. Additional NO_x control can be achieved by increasing the amount of exhaust-gas recycle, by adding an NO_x-reducing catalytic converter to the exhaust system, or by a combination of both techniques.

To approach the 0.4 g/mile NO_x level with a conventional spark-ignition engine, a combination of both techniques appears to be required. The use of large amounts of EGR (20 percent or more) results in a large fuel-economy penalty, severe driveability problems with attendant safety hazards, and an increase in engine HC and CO emissions. It is not practical at this stage to achieve NO_x-emission levels approaching 0.4 g/mile with EGR alone in a conventional engine.

Without EGR, engine NO_x emissions vary between about 3 and 8 g/mile, depending on the air-fuel ratio, spark timing, engine size, and other details of engine design and operation. In the dual-catalyst system, a separate NO_x-reduction catalyst is added to the exhaust system, between the engine and the oxidation catalyst. In the three-way catalyst system, a single catalytic converter simultaneously reduces the concentration of all three pollutants (HC, CO, and NO_x) in the exhaust stream. Air-fuel ratio must be closely regulated in such systems. The NO_x-reduction catalysts currently available, as will be described below, are not able to retain sufficient activity over extended mileage to reduce these engine emissions below the 1976 standards. Thus, unless further improvements in NO_x catalyst durability occur over the next year, only systems for conventional engines with increased EGR and an NO_x-reduction catalyst show any promise of approaching the 0.4 g/mile level. To minimize demands on catalyst size, cost, and durability, there is a continuing emphasis on achieving low and stable engine emissions. Techniques for controlling emissions during the first part of the test when the engine is still cold, fuel-metering requirements, EGR systems, and the potential for improved engine emissions control are examined next.

3.3.2 Cold-Start Emission Controls

With 1975-76 catalyst-based emission-control systems, a large portion of the carbon monoxide and hydrocarbon emissions occur during the cold-start and engine warm-up phase of the drive schedule in the CVS-CH test. To compensate for the low volatility of cold gasoline, a rich mixture must be provided during cold starts. The excess fuel is not fully burned in the combustion chamber, and the cold engine thus emits high levels of hydrocarbons and carbon monoxide. Because the oxidizing catalyst is inefficient while cold, large amounts of these contaminants are discharged to the atmosphere. Although the NO_x catalyst is also cold and ineffective during start-up, cold-start NO_x emissions tend to be lower because rich mixtures and cold cylinder walls reduce the formation of NO_x.

Because of the high HC and CO emissions during the cold start, considerable development effort has been spent in a number of cold-start controls and procedures. In the prototypes of their 1975 and 1976 systems, most manufacturers have elected to modify the cold-start process. Specifically, they have achieved start-up with leaner air-fuel mixtures by preheating the air and fuel, by improving the mixture control in the carburetor, and by shortening the choking period without seriously impairing cold engine operation and driveability. Most prototypes include air and fuel preheat systems and modified choke operation.

The purpose of preheating air and fuel is to achieve higher volatility with cold fuel, which, in turn, allows leaner engine operation and shorter choking period during warm-up. The air preheat system that has been incorporated in most 1970 and subsequent American-make cars, and has proven reliable, will be used in most 1975-76 models.

In addition to heating the intake air, several proposed emission-control systems promote further evaporation of the fuel by supplying heat to the base of the carburetor. This is accomplished by using a heat exchanger between the carburetor and the exhaust-manifold crossover, causing the fuel droplets to make contact with a hot surface and to flash into vapor. Several problems remain to be solved to ensure that production units can attain the emission reduction predicted by experimental designs. While durability of the system has not yet been evaluated, there appear to be no major technical difficulties.

A quick-acting choke, employing electrical or mechanical timing devices, will be used to lean out the mixture as early as possible after start-up. For systems incorporating air and mixture preheating, choking times have been reduced from several minutes to less than 30 seconds, while maintaining adequate driveability.

3.3.3 Carburetors

The precise metering of the fuel and air to automotive engines has become much more important in recent years because the mixture ratio is a critical parameter affecting the exhaust composition and the functioning of exhaust-treating devices. Most 1975-76 model carburetors have been redesigned to achieve better air-fuel ratio control and maintain good cold-start performance of the engine.

Except for the demands during extreme accelerations and decelerations, the newly designed carburetors are capable of maintaining tolerances of ± 3 percent of the set air-fuel ratio. This approaches the fuel-metering accuracy required for the dual-catalyst 1976 control systems in which the air-fuel ratio must be held between about 13.8 and 14.5 to achieve adequate NO_x reduction in the first catalytic converter.

Considerable design work remains to be done to ensure durability with these finely adjusted carburetors. Most manufacturers are considering factory-sealed, tamper-proof settings because it is believed impossible for a typical mechanic to make the required adjustments. The dependability of these factory-set adjustments is unknown.

3.3.4 Electronic Fuel Injection

Several companies are considering Electronic Fuel Injection (EFI) as an alternative to the carburetor. In such systems, an electronic module controls the amount of fuel provided to the engine.

An advantage of electronic control is that, by using appropriate transducers, air-fuel ratio can be compensated for variations in such operating parameters as engine speed, manifold vacuum, ambient conditions, various engine temperatures, exhaust composition, etc. Thus, there is potential for adequate control of mixture ratio over a wide range of operating conditions. EFI systems can respond quickly to changes in operating conditions and are therefore able to provide satisfactory control of air-fuel ratio under transient conditions. However, contacts made with carburetor manufacturers, automobile manufacturers, and producers of electronic fuel injection equipment indicate that current EFI systems do not provide substantial improvement in air-fuel control over the advanced-design carburetors operated under steady conditions.

EFI systems have been and are in production on several European cars. Field experience with these systems initially showed a high component-failure rate, although performance is improving. The advantage of EFI over current carburetors in small cars is in performance characteristics and fuel economy, i.e.,

- Increased power output, particularly for high-rpm high-performance engines
- Better fuel economy for high-speed driving
- Improved driveability, particularly with manual shift engines

At least one manufacturer is introducing a mechanically controlled fuel-injection system which may show performance comparable with the improved EFI system and at savings in cost.

3.3.5 Exhaust-Gas Recycle (EGR)

The most extensively developed technique for reducing engine NO_x emissions is the recycling of a fraction of the exhaust to the engine intake. The recycled exhaust gases dilute the fresh mixture, thus reducing peak combustion temperatures and NO_x-formation rates. The disadvantages of EGR are the loss in engine power and the reduction in tolerable air-fuel ratio variations consistent with smooth engine operation. The use of EGR requires some mixture enrichment to maintain adequate driveability, which results in a fuel-economy penalty. In most systems, EGR is cut out at wide-open throttle and idle operation.

EGR was introduced in most 1973 model year vehicles to bring NO_x below 3 g/mile. Experience from the durability testing of these EGR systems indicates that plugging of the recycle line and control valve with leaded fuels is a significant problem. But with unleaded fuels, and with regular inspection and cleaning of the system, these problems are not expected to be severe.

As the amount of EGR is increased to reduce NO_x engine emissions below 3 g/mile, there is a need for more precise matching of the recycle flow to fresh mixture flow, and for more uniform mixing of the recycled exhaust in the intake. Engine combustion-chamber redesign with higher turbulence levels to promote more rapid combustion also improves the tolerance of the engines to EGR.

3.3.6 Potential for Engine Emission Reduction

The methods of emission reduction discussed so far have been engine modifications that reduce emissions from the bare engine, i.e., before after-treatment devices such as catalysts and thermal reactors. The first two rows of Table 3-2 give typical engine emissions from a General Motors Corporation 1972 production audit. Both mean emissions and the standard deviation are given. The magnitude of the standard deviation indicates the spread in emissions about the mean value. This spread is due to differences in items such as brake setting, variations in transmissions, engine friction, carburetor settings, and stacking up

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TABLE 3-2

Engine Emissions at Low Mileage: Mean and Standard Deviation

	Emissions in grams/mile[a]					
	HC		CO		NO_x	
	mean	(S.D.)	mean	(S.D.)	mean	(S.D.)
GM 1972 production audit[b]	1.7	(0.64)	22	(8.3)	~4	(~1)[c]
Best GM division 1972 production	1.2	(0.32)	16	(6.2)	~4	(~1)[c]
Potential[d] best engine emissions, lean carburetion	1	(0.15)	10	(3)		2.5
Potential best[e] engine emissions, rich carburetion	1.5		25			1.5

[a] 1972 CVS-C test procedure

[b] 3656 vehicles tested

[c] California 7-mode test emissions multiplied by 2

[d] Standard-size engine, standard-size car, with quick heat manifold, improved carburetor, quick acting choke, and EGR

[e] Same as (d) and with air injection into the exhaust manifold

of engine tolerances. The best GM division has been able to reduce both mean engine emissions and the spread in emissions through improved production control, as indicated in the second row of the table.

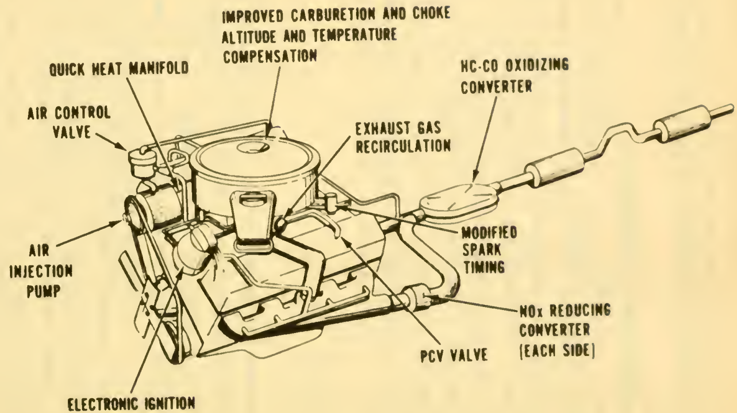
With the addition of a quick-heat manifold and an improved carburetor with a quick-acting choke, these HC and CO engine emissions can be improved. However, use of EGR to reduce NO_x emissions requires some mixture enrichment to compensate for the decreased flame speed, and engine HC and CO emissions rise. The last two rows in Table 3-2 are estimates of achievable engine emissions goals at low mileage for standard-size engines in standard-size vehicles. The third row corresponds to a lean and the fourth row to a richer carburetor setting. The further reduction of emissions in conventional engines must be achieved with exhaust treatment, such as catalysts or thermal reactors.

3.4 Catalysts

The control system for 1976 on which most development effort has been concentrated uses two catalyst beds to clean up the engine emissions before exhaust to the atmosphere. A typical system layout is shown in Figure 3-1. The bed closest to the engine is used to remove NO_x. It is operated under net reducing exhaust-gas conditions (between 1 and 2 percent carbon monoxide in the exhaust gas, corresponding to a slightly rich carburetor calibration). Air is then added to the exhaust stream between the catalyst beds, and the remaining HC and CO emissions are removed in the second catalyst, the oxidation bed. The two catalytic beds may be in separate containers as shown in the figure, or they may be packaged in a single container. The system is a logical development of the 1975 control system described previously.

Because the NO_x catalyst bed must be placed ahead of the oxidation bed, the oxidation catalyst warms up more slowly. Control of HC and CO emissions during start-up would thus be delayed if air were always injected between the catalyst beds. To maintain control over

FIGURE 3.1 TYPICAL DUAL-CATALYST SYSTEM



1976 HC and CO levels, air is diverted to upstream of the NO_x-reduction bed during the engine-warm-up phase. Thus the NO_x bed can act initially as an oxidation catalyst. Once the oxidation catalyst is warmed up, the air is diverted to between the two beds and the first catalyst acts primarily as an NO_x-reduction catalyst. (As an alternative, a "start" catalyst can be used ahead of the NO_x catalyst and bypassed after the engine is warm.)

The oxidation catalysts used in these dual-catalyst systems are the catalysts now being developed for 1975 model year vehicles. These consist of noble metals (platinum and/or palladium) or base metals promoted with noble metals (a small amount of noble metal required to initiate activity) deposited on both monolithic and pellet substrates. Except for precious metals, there appears to be no problem of supply of raw materials for the active ingredient and the support in the catalysts contemplated. The early state of development of oxidation catalysts was described in the previous Committee report. Several companies now have products that have demonstrated adequate initial activity, and some of these have reasonable durability.

The NO_x catalysts tested to date include noble metals (platinum, ruthenium, palladium), base metals, or base metals promoted with noble metals, deposited on both monolithic and pelleted ceramic substrates. Nickel-copper and Inconel metallic monolithic NO_x catalysts are also being tested. Reduction catalysts are generally less well developed than oxidation catalysts. Whereas several NO_x catalysts have demonstrated sufficient initial activity, the limited amount of durability data currently available is not encouraging. Several examples of the best low-mileage emission data available are shown in Table 3-3.

Only a few 1976 experimental vehicles have been tested to evaluate NO_x catalyst durability. Before attempting extensive durability tests, most manufacturers are working to optimize the performance of the system to reduce low-mileage emissions to values at least 50-60

TABLE 3-3

Examples of Best Low Mileage Emissions Measurements with Dual-Catalyst Systems on Experimental 1976 Vehicles

Company	Vehicle Weight Lb.	Engine Size CID	EGR	Emissions in g/mile[a] HC	CO	NO_x	Catalyst Data (a) HC/CO (b) NO_x
American Motors		258		0.27	5.7	0.55	
Esso	4500	350	No	0.09	1.0	0.2	(a) Engelhard (b) Gould GEM
Volvo	3500	85	Yes	0.19	2.2	0.4	(a) Base, Pellet (b) Base, Pellet
	3500	85	Yes	0.41	3.4	0.38	(a) Noble, Monolith (b) Noble, Monolith
General Motors	4500	350	Yes	0.24	1.7	0.15	(a) UOP, Platinum, Pellet (b) Gulf, Monolith
	4500	350	Yes	0.42	3.1	0.21	(a) Air Products, Pellet (b) Gulf, Pellet
	4500	350	Yes	0.17	1.0	0.19	(a) UOP, Platinum, Pellet (b) Johnson-Matthey, Monolith
	4500	350	Yes	0.21	1.0	0.22	(a) UOP, Platinum, Pellet (b) Johnson-Matthey, Monolith
	4500	350	Yes	0.37	1.8	0.27	(a) UOP, Platinum, Pellet (b) GM, Pellet
Chrysler		360	No	0.17	3.0	0.5	(a) (b) Noble, Monolith
		360	No	0.23	2.5	0.52	(a) (b) Base
		360	Yes	0.34	3.9	0.44	(a) (b) Noble, Pellets

TABLE 3-3 (Cont'd)

Company	Vehicle Weight Lb.	Engine Size CID	EGR	Emissions in g/mile[a] HC	CO	NO_x	Catalyst Data (a) HC/CO; (b) NO_x
Ford	4000	250	No	0.45	2.9	0.38	(a) Engelhard, Monolith (b) Promoted Base, Pellet
	5000	351	No	0.43	2.4	0.27	(a) Engelhard, Monolith (b) Gould, GEM
	4000	250	No	0.52	3.7	0.39	(a) Engelhard, Monolith (b) ICI, Pellet
	5000	351	Yes	0.48	3.3	0.39	(a) Engelhard, Monolith (b) ICI, Pellet
Daimler-Benz		350	Yes	0.20	1.4	0.33	(a) Chemico, Base, Pellet (b) Chemico, Base, Pellet
			Yes	0.15	1.2	0.3	(a) Noble, Monolith (b) Noble, Monolith
Nissan	2750	98	Yes	0.1-0.2	0.4-1.2	0.3	(a) (b) Johnson-Matthey, Noble, Monolith
Johnson-Matthey Ricardo	2700	110	No	0.17	1.8	0.25	(a) Johnson-Matthey, Noble, Monolith (b) Johnson-Matthey, Noble, Monolith
Volkswagen	2500	98-104	Yes[b]	0.38	2.2	0.64	(a) Monolith, Noble (b) Monolith, Noble
	2500	98-104	Yes[b]	0.49	4.9	0.46	(a) Monolith, Noble (b) Monolith, Noble
	2500	98-104	Yes	0.82	4.0	0.57	(a) Monolith, Noble (b) Monolith, Noble

TABLE 3-3 (Cont'd)

Company	Vehicle Weight Lb.	Engine Size CID	EGR	Emissions in g/mile[a]			Catalyst Data
				HC	CO	NO_x	(a) HC/CO; (b) NO_x
Toyota	2500	97	Yes[b]	0.39	2.7	0.5	(a) Palladium, Pellet (b) American Oil, Base, Pellet
	2500	97	Yes[b]	0.29	3.0	0.54	(a) Palladium, Pellet (b) American Oil, Base, Pellet
	2500	97	Yes	0.39	3.7	0.39	(a) Palladium, Pellet (b) Toyota, Platinum, Pellet

Note:

a - 1975 CVS-CH test procedure. Data usually averages of several tests.

b - Emission-control systems include a manifold thermal reactor before the NO_x-reduction catalyst.

percent below the 1976 standards levels, to improve vehicle driveability, and to hold performance losses to a minimum. Since NO_x-catalyst durability is substantially inferior to that of the best oxidation catalysts, a production goal of .25 g/mile does not seem unreasonably stringent.

The results of the most promising durability tests of some dual-catalyst vehicles are summarized in Table 3-4. Emissions are shown as a function of mileage. Where engine-emissions data are available, the average catalyst-conversion efficiencies over the entire CVS-CH driving cycle can be estimated and are shown in the table. Conversion efficiency is the percentage of entering emissions removed in the converter. These data show that the initial high conversion efficiency rapidly deteriorates.

The causes of this rapid deterioration in NO_x-catalyst efficiency are not yet quantitatively understood. Catalysts have a long history of success in the petroleum and chemical industries; the major processes in these industries employ steady-state conditions of temperature, pressure, and flow rate of gases, with careful exclusion of poisons. Many automobile catalysts developed today would work similarly well and probably last 50,000 miles if they could work within narrowly defined operating ranges (or "windows") in each of four variables: temperature, gas composition, gas flow, and poison concentrations. Catalysts can tolerate occasional excursions from these windows, but prolonged excursions invariably lead to slow chronic aging or quick massive failures.

In actual practice, an automobile is always in a transient condition: the catalyst is too cold during start-up and too hot during a long down-hill cruise; the air-fuel ratio is too rich on idle and too lean during high speed; the exhaust-gas flow is slow during idle and fast during upgrade cruise. The catalysts are also exposed to repeated cycles of heating and cooling, evaporation and condensation of water, pulsating flow from exhaust gases, vigorous shaking on the road, and a variety of poisons including lead and sulfur. Under these excursions from the windows, catalysts deteriorate rapidly.

TABLE 3-4

Emissions As Function of Mileage for Durability Tests on Dual-Catalyst Systems

Manufacturer, Vehicle [a]	Catalysts (a) HC/CO (b) NO_x	Mileage	Emissions, g/mile[b] HC	CO	NO_x	NO_x Catalyst Efficiency[c] percent
GENERAL MOTORS						
(1) 4500 pounds	(a) UOP, noble,	0	-	-	0.22	78[d]
350 CID	pellet.	1000	0.32	1.7	0.42	58[d]
Chevrolet	(b) Gulf, noble,	7000	0.39	3.0	0.45	55[d]
EGR	pellet.	13000	0.52	4.8	0.73	27[d]
(2) 4500 pounds	(a) UOP, noble,	0	0.21	1.0	0.21	79[d]
350 CID	pellet.	7000	0.47	1.8	0.59	41[d]
Chevrolet	(b) Johnson-Matthey,					
EGR	noble, monolith.					
(3) 4500 pounds	(a) UOP, noble	0	0.36	1.8	0.28	72[d]
350 CID	pellet.	4000	0.57	4.1	0.51	49[d]
Chevrolet	General Motors					
EGR	Research,					
	pellet.					
FORD						
(1) 5000 pounds	(a) Engelhard, mono-	low	0.3	1.5	0.56	78
351 CID	lith.	3000	0.33	1.5	0.49	80
Ford	(b) monolith.	6000	0.48	2.6	0.70	71
EGR		9000	0.72	1.9	0.89	63
	8-10 grams of	12000	0.66	3.6	0.75	64
	platinum,[e] dual-	16000	0.66	5.4	1.3	46
	bed converter.	20000	0.82	3.8	1.5	37
(2) 5000 pounds	(a) Pellet	low	0.35	3.8	0.68	70
351 CID	(b) Pellet	1000	0.61	3.3	0.99	-
Ford		2000	0.59	3.6	1.25	-
EGR	Dual-bed converter	6000	0.68	4.2	1.72[f]	25

TABLE 3-4 (Cont'd)

Manufacturer,[a] Vehicle	Catalysts (a) HC/CO (b) NO_x	Mileage	Emissions, g/mile[b] HC	CO	NO_x	NO_x Catalyst Efficiency[c] percent
FORD (Cont'd)						
(3) 4000 pounds	(a) -	low	0.52	3.7	0.39	89
250 CID	(b) ICI, pellet	4000	0.65	5.2	0.48	86
Ford						
No EGR						
NISSAN						
(1) 2750 pounds	(a) Noble, pellet	0	0.19	0.5	0.28	70
98 CID, EGR	(b) Johnson-Matthey	3000	0.32	1.1	0.7	37
	noble, monolith	7300	0.34	1.7	1.1	6
		13900	0.67	2.7	1.1	
(2) 2750 pounds	(a) Noble, pellet	0	0.1	0.4	0.3	84
98 CID, EGR	(b) Johnson-Matthey	5200	0.33	2.2	1.3	30
	noble, monolith					
(3) 2750 pounds	(a) Noble, pellet	0	0.17	1.2	0.27	67
98 CID, EGR	(b) Johnson-Matthey	3100	0.38	1.8	0.5	38
	noble, monolith					
TOYOTA						
(1) 2500 pounds	(a) Palladium,	0	0.39	2.7	0.5	-
97 CID	pellet	12000[g]	0.46	2.8	0.82	-
Reactor, EGR	(b) American Oil,	20000[g]	0.50	3.1	0.93	-
	base, pellet					
(2) 2500 pounds	(a) Palladium,	0	0.29	3.0	0.54	-
97 CID	pellet	12000[g]	0.49	3.5	0.81	-
Reactor, EGR	(b) American Oil,	28000[g]	0.52	5.7	1.5	-
	base, pellet					

TABLE 3-4 (Cont'd)

Manufacturer, Vehicle [a]	Catalysts (a) HC/CO (b) NO_x	Mileage	Emissions, g/mile[b] HC	CO	NO_x	NO_x Catalyst Efficiency[c] percent
TOYOTA (Cont'd)						
(3) 2500 pounds 97 CID Reactor, EGR	(a) Palladium, pellet (b) Toyota, platinum, pellet	0	0.39	3.7	0.39	-
		4000	0.45	4.2	0.51	-
		8000	0.40	4.3	0.94	-
		12000	0.59	4.4	1.09	-
		16000	0.31	4.3	0.38	-

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a - Emission Control System includes engine modifications, air pump, NO_x catalytic converter, oxidation catalytic converter, and EGR and manifold reactor where noted.

b - 1975 CVS-CH test procedure.

c - NO_x catalyst efficiency is percent NO_x removed in catalytic converter.

d - NO_x catalyst efficiency estimated from approximate engine NO_x emission of 1 gram/mile.

e - Catalyst judged by vendor not to be available in commercial quantities.

f - EGR system failure.

g - Emissions at these mileages measured after maintenance.

The rate of the deterioration due to inadequate control of air-fuel ratio in the engine and the temperature fluctuation in the catalyst bed has not been quantified. Thermal degradation of the catalyst can occur due to damage to the surface structure caused by overheating. The presence of an oxidizing atmosphere even for short periods of time when the catalyst is hot is known to be detrimental, especially to the nickel-copper alloy metallic catalysts. The loss of catalytic material both from noble metal and base metal NO_x catalysts has also been observed to occur, probably due to oxidation.

It is clear that poisoning of the active catalyst material by contaminants in the fuel is the cause of some deterioration. During the last two years, it has become evident that the oxidation catalysts being tested in 1975 prototype vehicles deteriorate as a consequence of the trace quantities of lead, phosphorus, and other elements in lead-free fuels and lubricants. It is anticipated that, as a result of EPA regulations*, the lead-free fuel available in 1975 and 1976 will have average contaminant levels of about 0.03 grams/gallon lead, less than 0.005 grams/gallon phosphorus, and about 0.04 percent sulfur by weight. It is not known how severely these contaminant levels will affect the activity of the different NO_x catalysts now being evaluated. Laboratory tests on a noble metal NO_x catalyst which contained platinum and other metals showed lead poisoning of magnitude comparable to that observed with platinum oxidation catalysts. Sulfur also affected the activity of this NO_x catalyst at levels of 0.04 percent by weight or more. However, a ruthenium NO_x catalyst appeared in bench tests to be much more resistant to lead poisoning. There are NO_x catalysts of both noble metal and copper-nickel that are remarkably resistant to lead levels up to 0.5 gram/gallon. NO_x catalysts may have the ability to partially recover from sulfur poisoning if operated in an oxidizing atmosphere at high temperatures.

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*In a proposed rule-making, EPA has recommended maximum contaminant levels of 0.05 grams/gallon lead and 0.01 grams/gallon phosphorus. It is assumed that average contaminant levels will be about half the maximum levels.

The ability to control air-fuel ratio within narrow limits with dual-catalyst systems is critical. It is well known that, under certain operating conditions, nitric oxide, NO, is reduced in the NO_x-catalyst bed to ammonia, most of which is then oxidized back to NO in the oxidation catalyst. Ammonia formation increases with carbon monoxide level in exhaust mixtures. Thus, whereas the air-fuel mixture must be slightly fuel-rich to provide net reducing conditions at the NO_x-catalyst bed, too great a CO level leads to excess ammonia formation and results in increased concentrations of NO in the exhaust. It appears that the air-fuel ratio must be controlled to give about 1 to 2 percent CO in the exhaust, corresponding to an air-fuel ratio of 13.8 to 14.5.

Progress is being made in the development of NO_x catalysts for automotive use. However, to retain its effectiveness, it is necessary that the catalyst be integrated into the engine-emission-control system to protect the catalyst from long excursions from its operating windows. Unfortunately, coordination of research by the automobile manufacturers and catalyst suppliers is far from ideal. The composition of the catalyst supplied to the auto manufacturer for testing is proprietary to the catalyst supplier; when failures occur during durability testing, the catalyst must be returned to the catalyst supplier for further analysis. 50,000-mile durability testing requires three to four months, 25,000-mile testing takes six to eight weeks. The process is a slow one. Many months may elapse from the time a catalyst is supplied to the time data may be available that could lead to an improved catalyst composition.

3.5 Three-Way Catalysts

Several catalyst manufacturers are developing single-bed catalysts that, under carefully controlled operating conditions, will simultaneously promote oxidation of HC and CO and reduction of NO_x.

Successful operation of such a three-way catalyst has been found to occur in a narrow window of air-fuel ratio, slightly on the rich side of stoichiometry.* The width of this window has been found to be only ± .1 air-fuel ratio, thus requiring an overall control of air-fuel ratio to within less than ± 1 percent. Lean-side deviations from this window result in a drastic loss of NO_x conversions; rich-side deviations lead to considerable loss of HC and CO oxidation efficiencies and increased ammonia formation. The difficulties of maintaining such a close control of air-fuel ratio during all the transient conditions that occur during typical operation of an automobile have been cited in Section 3.4.

If a three-way catalyst could be successfully incorporated into a vehicle and proved to possess adequate durability, a simpler system than the dual-catalyst system would result. Since there is enough oxygen present in the exhaust gas, the air pump would no longer be required. One catalyst bed would be eliminated, and the difficulties of heating up the catalyst beds rapidly to control cold-start emissions would be simplified. Vehicle driveability is known to be good with a stoichiometric air-fuel mixture, and the fuel economy for a given engine would be reasonably close to optimum.

3.6 Feedback Control for Air-Fuel Ratio

The need for more close control of exhaust-gas composition both in the dual-catalyst and the 3-way catalyst system has led to the investigation of methods of achieving more precise fuel and air metering. A method that has met with some success and is under development in several European and American companies is a feedback, or closed-loop, system of fuel metering. In such a system, an oxygen sensor is used to detect the level of oxygen in the exhaust stream and to supply

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*The stoichiometric air-fuel ratio is the theoretical ratio for complete combustion.

an error feedback signal either to an electronic fuel-injection (EFI) control module or to a specially constructed carburetor. This signal causes adjustments in the fuel or air supply, thereby maintaining close control of air-fuel ratio. Unfortunately, these oxygen sensors function only when hot and are thus ineffective in controlling cold-start emissions.

Because the oxygen sensor is an electrical tranaducer, it is particularly well suited for adaptation to the electronic circuitry of the EFI control module. Also, fuel-injection systems provide quicker response to error signals than do carburetors. The EFI syatem or carburetor used must be able to control air-fuel ratio to within $\pm$ 5 percent of stoichiometry without feedback; the sensor feedback system at present has limited control authority so that it cannot correct for deviations outside this range. Current EFI systems and advanced carburetors can achieve this degree of air-fuel ratio control during steady-state operation, but deviate significantly outside the $\pm$ 5 percent range during transient vehicle operation such as acceleration and deceleration. To obtain full benefit from the sensor-feedback system, improvements in the performance of the basic EFI or carburetor will be required.

The sensor is expected to be inexpensive and a life of about 12,000 miles is the development target. The sensor could then be exchanged as a spark plug.

The durability of oxygen sensors now available is inadequate, and their life in a vehicle is only a few hours. The major problems are thermal shock, erosion of the electrodes, and maintaining good electrical contacts with the sensor. In addition, bench tests have shown that the sensor can be poisoned by lead, sulfur, phosphorus, and other impurities. Considerable development will therefore be required before the sensor and feedback system is ready for mass production.

If the durability and poisoning problems are solved, the oxygen sensor could make an important contribution to lowering emission levels and improve durability of the catalysts in the exhaust system by avoiding large variations in exhaust composition and temperature during operation of the engine.

Developments on feedback systems have been proceeding most intensively in Europe, where the performance gains of fuel-injection systems on smaller, higher-speed engines are more significant. Test results on six different European vehicles are summarized in Table 3-5. Also shown are data from Bendix, also with a compact car. These results are at low mileage; durability data are not yet available.

The sensor-feedback concept also can be used to control air-fuel ratio, and thus exhaust-gas composition, with the dual-catalyst emission-control system. This system is more complex than the three-way catalyst approach since an air pump is required to supply secondary air upstream of the oxidation catalyst, and air must be diverted to upstream of the NO_x-reduction catalyst during the cold-start portion of the test. Again, the elimination of exhaust-gas composition excursions outside the desirable operating window of the catalysts would be expected to improve catalyst life, and there is a better chance to develop separate oxidation and reduction catalysts by a given time than to find a three-way catalyst adequate to the job.

Several parallel developments are necessary to make the oxygen-sensor feedback-control catalyst system more than a promising concept. First, the oxygen sensor must be shown to be durable in the exhaust environment of an operating vehicle with commercially available lead-free fuels. Second, the EFI system or carburetor must be improved to provide control of air-fuel ratio to within $\pm$ 5 percent of stoichiometric for all engine operating modes, or the effective range of the feedback system must be extended. Finally, either the durability of the catalyst in the three-way system must be demonstrated, or a durable

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TABLE 3-5

Low-Mileage Emissions from Compact and European Vehicles Equipped with Three-Way Catalyst System

	Emissions in grams/mile		
	HC	CO	NO_x
Six Volkswagen vehicles with Bosch EFI and O_2 sensor; 5% EGR, and noble metal monolithic three-way catalysts.			
60-test average	0.15	2.2	0.21
Range	0.1 - 0.25	1.1 - 3.3	0.1 - 0.35
Bendix tests on 2500-lb vehicle, 150-CID 4-cylinder engine, EFI and O_2 sensor, 8% EGR			
6-test average	0.24	2.8	0.35
Range	0.18 - 0.30	2.1 - 3.2	0.31 - 0.37

NO_x-reduction catalyst must be developed for the dual-catalyst system. The effects of fuel contaminants and temperature fluctuations on the catalyst activity and size of the required air-fuel ratio operating window are unknown at this time.

3.7 Thermal Reactors

A substantial amount of work has been done on emission-control systems that incorporate a thermal reactor, a chamber in which HC and CO emissions are burned after leaving the engine. Typically the reactor is bolted to the cylinder head in place of the normal exhaust manifold, although some systems employ thermal reactors further back in the exhaust system. Some systems combine a thermal reactor with catalysts; some use a thermal reactor alone.

There have been two basic versions of systems using a thermal reactor only: fuel-rich and fuel-lean systems. The fuel-rich system results in less NO_x formation, but only at the expense of substantially poorer fuel economy. The lean system does not require air injection, so it has the advantage of being simpler. Fuel-rich reactor cars typically operate in the range of air-fuel ratios from 11:1 to 13:1, while lean reactor cars operate at air-fuel ratios of 17 to 19:1, depending upon the degree of exhaust-gas recirculation. These ranges of operation result in acceptable but not always good driveability.

A major difficulty in thermal-reactor systems has been achieving high enough gas temperature inside the reactor to burn up the engine HC and CO emissions. In the rich-reactor approach, the chemical energy in the exhaust is used to obtain core gas temperatures of up to $1800^{\circ}F$. Rich reactor systems achieve better emissions control than lean reactor systems, but have a much higher fuel-economy penalty and have more severe durability problems because of the higher temperatures.

Systems that combine one or more thermal reactors with catalytic converters are also being developed. In most of these systems, the thermal reactor bolted to the cylinder head is used to achieve partial burn-up of the engine HC and CO emissions to reduce the load on the oxidation catalyst downstream.

General Motors is developing a reactor-catalyst combination called a triple-mode system. The aim of the system is to avoid damaging the NO_x and oxidation catalyst beds by overheating during engine operation at high load. At about 55 mph vehicle speed, the dual-catalyst system is bypassed through a thermal reactor. HC, CO, and NO_x emissions from the vehicle are all higher during the bypass mode. At lower speeds, the bypass is sealed with a valve. This system has met the 1976 standards at low mileage; its durability has yet to be established. The system is more complicated than the dual-catalyst system; the development of an effective valve is a formidable problem since the bypass must be sealed tight when not in use; and the emissions at high vehicle speed are higher than values obtained with the dual-catalyst system alone. The claimed, but yet to be demonstrated, advantage is that catalyst life would be extended by the elimination of prolonged high-temperature catalyst operation.

Another reactor-plus-catalyst approach is being developed by Questor. Their system consists of a small-volume thermal reactor bolted onto the cylinder head, in which partial oxidation of engine HC and CO emissions occurs, followed by an Inconel 601 screen NO_x-reduction catalyst, followed by a final oxidizing thermal reactor. Air is injected into the exhaust ports and downstream of the NO_x catalyst. The engine is operated fuel-rich, so there is a fuel economy penalty relative to the 1971 production test vehicle of 25 percent in stop-and-go driving. Low-mileage emissions are below the 1976 standards, and some durability has been demonstrated. Mileage accumulation is being done with highly leaded fuels, and lead poisoning of the catalyst appears not to be a problem. Catalyst overheating is controlled by water injection.

3.8 Wankel Engine

The Wankel rotary engine is being developed by some manufacturers because it offers the potential of being a small, smooth-running, lightweight, relatively inexpensive power plant. Fuel economy of the bare engine is generally poorer than that of a piston engine of comparable power, and there have been durability problems, but development is continuing.

At the present state of development, emissions from an uncontrolled Wankel engine compare with those of an uncontrolled piston engine of equivalent power approximately as follows: hydrocarbons 2-5 times higher, carbon monoxide 1-3 times higher, and oxides of nitrogen 25-75 percent lower.

The effect of EGR on emissions from a Wankel engine without a catalyst or thermal reactor is shown in Table 3-6. With penalties in fuel economy and driveability, EGR can be quite effective in reducing NO_x emissions. However, HC and CO emissions are high, and these can be reduced to approach the 1975/76 standards only by using external emission-control devices. The small engine size provides an advantage in packaging these devices.

With its inherently high exhaust temperatures and its exhaust ports all adjacent, the Wankel engine is particularly well suited to emission control by a thermal reactor. Current production rotary engines on compact cars operated with rich carburetor settings and thermal reactors have been developed to meet the 1975 standards with NO_x levels of about 1 gram per mile. However, the fuel-economy penalty compared with a current equivalent piston engine is about 30 percent. The use of EGR and richer carburetion with the thermal reactor reduces

TABLE 3-6

Effect of EGR on Wankel Bare Engine NO_x Emissions*

Condition	Emissions in grams/mile** HC	CO	NO_x	Driveability
Baseline Engine	19	50	2.5	Production
Driveability limited EGR	19	50	1.4	Poor
Richer carburetor setting + EGR	20	65	0.75	Acceptable
Leaner carburetor improved induction system, EGR	19	55	0.3	Acceptable

* General Motors Data at low mileage, 2750 lb car
** 1975 CVS-CH test procedure

NO_x-emission levels, but not yet to 0.4 grams per mile with adequate driveability. The fuel-economy penalty increases by a further 5 percent. Table 3-7 lists the best emission levels obtained with thermal-reactor Wankel-engine systems. Several of these cars have met the levels of the 1975 standards, and one has nearly met the 1976 levels.

Toyo Kogyo has demonstrated durability of the rich thermal-reactor system by testing one car successfully to 50,000 miles, and with another still under test at 28,000 miles. The emissions from these cars have remained below the 1975 standards, and work to achieve the 1976 NO_x requirement is continuing.

The best results achieved with oxidation catalysts and rotary engines are shown in Table 3-8. Levels approaching the 1975 standards for HC and CO have been achieved at low mileage with a compact car.

Other control approaches with the Wankel engine have been less extensively developed. At leaner carburetor settings, oxidation catalysts have been shown to reduce HC emissions at low mileage in a compact car to levels about 50 percent above the 1976 standards, and CO to well below the standard. However, the durability of the rotary-engine systems with catalysts has not been evaluated. EGR has been shown to reduce NO_x levels below 0.4 grams per mile, but engine HC and CO emissions were comparable to uncontrolled piston-engine levels.

3.9 Stratified-Charge Engines

Stratified-charge spark-ignition engines are being developed to remove some of the performance and emissions limitations of conventional spark-ignition engines by controlling the air-fuel mixing and combustion process occurring inside the engine cylinder. The basic concept is not new and was first suggested in the early 1920's. Two stratified-charge engine types have been developed to the multi-cylinder engine stage.

TABLE 3-7

Best Emissions Results, Thermal Reactor and Wankel Engine 2750-lb Compact Car

Manufacturer	System*	Mileage	No. of Tests	Emissions in g/mile**			Fuel Penalty***
				HC	CO	NO_x	percent
Toyo Kogyo	Reactor	4,000	Many	0.32	3.1	0.83	6.5
		50,000	3	0.36	2.6	0.87	
	Reactor + EGR	low	8	0.35	2.2	0.49	12.0
General Motors	Reactor	low	72	0.60	5.0	0.60	
	(best effort)	low	1	0.43	2.8	0.44	

*All these systems are carbureted fuel rich (about 12:1)

**1975 CVS-CH test procedure

***Relative to 1973 production rotary engine car

TABLE 3-8

Emissions at Low Mileage, Rotary Engine with Oxidation Catalyst*

System	No. of tests	Emissions grams/mile**		
		HC	CO	NO_x
Oxidation catalyst and air pump	22	0.7	0.4	1.2
(Best Effort)	1	0.4	0.2	1.0

*General Motors data, 2750-lb car
**1975 CVS-CH test procedure

3.9.1 Fuel-Injected Stratified-Charge Engines

This stratified-charge engine concept employs a combination of air inlet port swirl and high-pressure timed combustion-chamber fuel injection to achieve a local fuel-rich ignitable mixture near the point of ignition while the overall air-fuel ratio supplied to the engine is fuel-lean for most operating conditions.

Research and development on this concept, the open-chamber stratified-charge engine, has been sponsored by the U.S. Army Tank and Automotive Command (TACOM) for a number of years. This work has involved development and testing of two engine designs, one based on the Ford Programmed Combustion Process (PROCO) and the other based on the Texaco Combustion Process (TCP). The present TACOM vehicles employ exhaust-gas recirculation for NO_x control and oxidizing catalysts for control of carbon monoxide and particularly unburned hydrocarbons. As a consequence, the usual problems with oxidizing catalyst durability have been experienced. These engines are four-cylinder engines nominally rated at 70 horsepower for the military jeep.

Military vehicles equipped with four-cylinder L-141 engines modified by both Ford and Texaco are currently undergoing emissions durability tests. Emissions levels for these vehicles, which are equipped with oxidizing catalysts and exhaust-gas recirculation, are presented in Table 3-9 for the Ford and Texaco vehicles. Results indicate that with low vehicle mileage these systems are capable of meeting the 1976 federal emissions standards. Durability results are also presented. The most important conclusion from the durability tests is that the basic combustion process is stable. Difficulties with plugging of EGR systems with particulates were experienced during this mileage accumulation. The Ford engine required two catalyst changes and frequent maintenance. The Texaco engine used three oxidation catalysts in series to achieve the required HC and CO emission control. These engines are still in the research stage and are not production

TABLE 3-9

Emissions from Military Jeep with Stratified-Charge Engine[a]

Engine	Mileage	Emissions grams/mile[b]		
		HC	CO	NO_x
L -141 Ford PROCO	low	0.37	0.93	0.33
	17,123[c]	0.64	0.46	0.38
L-141 Texaco TCP[d]	low	0.37	0.23	0.31
	10,000	0.77	1.90	0.38

[a]Emission controls include oxidation catalyst, EGR, throttling at light load.

[b]1975 CVS-CH test procedure.

[c]Vehicle required two oxidation catalyst changes during the 17,123 mileage durability testing.

[d]Three oxidation catalysts in series used to achieve low HC and CO emissions.

prototypes. Durability tests with these vehicles are continuing at the present time. In addition to work performed under contract to TACOM, Ford has conducted experiments involving this type of engine in passenger cars. Both four-cylinder and eight-cylinder engine conversions have been used. In addition, stratified-charge engine installations have been made on two commercial-type vehicles. It is evident from Table 3-10 that several of the vehicles under test in this program are capable of meeting the 1976 federal emission standards at low vehicle mileage.

One of the advantages of the stratified-charge engine is excellent fuel economy relative to conventional engines, particularly when emissions controls are applied. The original version of the stratified-charge L-141 engine developed for optimum fuel economy showed a 30 percent fuel economy gain over the conventional carbureted engine. However, as in a conventional engine, when EGR is used to reduce NO_x emissions, the fuel economy is reduced. With NO_x emissions at 0.33 grams per mile, the emissions-controlled stratified-charge engine fuel economy is comparable to that of the original L-141 conventional engine. With less EGR, at 0.7 grams per mile NO_x, about a 10 percent fuel economy gain is obtained.

3.9.2 Carbureted Stratified-Charge Engine

An alternative approach, the CVCC system, now being developed by Honda, achieves charge stratification with a prechamber and dual carburetor. The engine uses a conventional engine block, pistons, and spark plugs; only the cylinder head, intake and exhaust manifolds, and carburetor are modified. The cylinder head contains a small precombustion chamber in addition to the main combustion chamber. The spark plug is located in the prechamber, which is fed through a separate carburetor and intake system with a fuel-rich mixture through a small third valve. The main carburetor and intake system feeds a fuel-lean mixture to the normal intake valve.

Table 3-10

Low-Mileage Emission Levels for PROCO Conversion
(Figures are Averages for Number of Tests Shown)

(All vehicles use EGR and noble metal catalysts)

	CVS/CH Test, Grams/Mile			CVS Fuel Economy, Miles/Gallon	Inertia Test Weight, Pounds	No. of Tests
	HC	CO	NOx			
PROCO 141-CID Capris	0.12	0.46	0.32	20.4	2500	6
	0.13	0.18	0.33	25.1	-	-
	0.11	0.27	0.32	22.3	2500	-
PROCO 351-CID Torino	0.30	0.37	0.37	14.4	4500	5
PROCO 351-CID Montegos	0.36	0.13	0.63	-	-	-
	0.33	1.08	0.39	12.8	-	-
M-151 PROCO ½-Ton Truck	0.12	0.30	0.34	20.2	3000	4
½-Ton PROCO Mail Truck	0.18	0.21	0.51	22.9	2500	9

The fuel-rich mixture ensures good ignition; the approximately stoichiometric mixture at the prechamber exit propagates the flame into the fuel-lean mixture in the main chamber. A slow-burning flame is required to reduce NO_x formation and allow HC and CO burnup inside the engine. Emissions of NO_x, CO, and HC are all lower than those of a conventional engine at the same lean air-fuel ratios.

In February 1971, emissions data with this system on engine dynamometer tests indicated the engine could meet 1975 standards; the first successful car test that met the standards was in Spring 1972. In addition to developing a 2-liter, 4-cylinder engine for their own vehicle, Honda has applied the same techniques to modify two Chevrolet Vega 4-cylinder engines.

The Honda system is the most developed stratified-charge engine to date and has the lowest bare-engine emissions. Low-mileage emissions data are given in Table 3-11 for 54 Honda vehicles and two modified GM Vegas. All these cars met the 1975 standards without EGR or exhaust treatment, and Honda has expressed confidence that larger engines using the CVCC approach could also be made to meet 1975 standards without a catalyst. Especially impressive is the standard deviation of the low-mileage emissions of these vehicles. The standard deviation is 10 to 15 percent of the mean emissions. In comparison, mass-produced conventional-engine vehicles show standard deviations of 30 percent of the mean at higher emission levels.

Three Honda cars have completed 50,000-mile durability testing and met the 1975 standards with ease at every 4,000 miles. Data for these tests are given in Table 3-12. The Federal Test Procedure 11-lap mode was followed in these tests. Maintenance required was minor.

In a recent series of three tests at low mileage, the average emissions measured were 0.25 grams per mile HC, 2.5 grams per mile CO,

TABLE 3-11

Low-Mileage Emissions Data from Honda Tests of CVCC System

Vehicle	Engine Displacement, cubic inches	Number of Vehicles	Emissions grams/mile*		
			HC	CO	NO_x
Honda Civic with CVCC Manual Transmission	122	25	0.23	2.41	0.95
Honda Civic with CVCC Automatic Transmission	122	3	0.23	2.60	1.15
Honda Civic with Improved CVCC Manual Transmission	122	25	0.21	2.33	0.75
Honda Civic with Further Improvements Manual Transmission	122	1***	0.25	2.5	0.43
Original GM Vega Manual Transmission	140	1	2.13	10.6	3.80
GM Vega with CVCC Manual Transmission	140	1**	0.26	2.9	1.18
GM Vega with Improved CVCC Manual Transmission	140	1**	0.26	2.62	1.16

* 1975 CVS-CH test procedure

** Two-test average

*** Average of three tests

Data for this table current on November 24, 1972

TABLE 3-12

Durability Data from Honda Tests of CVCC System

Vehicle No.	Miles*		Emissions, HC	Emissions, CO	Emissions, NO_x	Deterioration Factor HC	Deterioration Factor CO	Deterioration Factor NO_x
1006	4,000		0.22	2.4	0.96	1.16	1.07	1.03
	50,000		0.26	2.6	0.99			
2033	4,000		0.21	2.7	0.95			
	50,000	Extrapolated**	0.25	2.7	0.90	1.15	1.08	1.04
	50,000	Actual	0.21	2.2	0.93			
2034	4,000		0.25	2.5	0.89			
	50,000	Extrapolated**	0.25	2.6	0.82	1.06	1.05	0.98
	50,000	Actual	0.22	2.2	0.70			
2035	4,000		0.21	2.4	0.95			
	50,000	Extrapolated**	0.24	2.7	0.96	1.12	1.12	1.00
	36,000	Actual	0.19	2.2	0.80			

*Mileage accumulation for vehicle No. 1006 was obtained on a chassis dynamometer. The other three vehicles were run on a proving ground.

**Vehicles 2033, 2034, and 2035 were modified to an improved version before the 50,000-mile testing was completed. Thus, to calculate deterioration factors, emission values at 50,000 miles were extrapolated from preceding measurements.

Data for this table were current on November 24, 1972.

and 0.43 grams per mile NO_x. These levels were achieved by improving the configuration of the auxiliary combustion chamber and the air-fuel control pattern. No EGR or exhaust-treatment devices were used.

The emissions are not especially sensitive to variations in air-fuel ratio. Thus the required performance of the double carburetor system is no more demanding than current requirements. The two throttle plates are linked mechanically. The mean air-fuel ratio varies with operating mode.

The new cylinder head is about the same height as a conventional head. The new head, intake, and carburetor on the modified Vega fit comfortably into the engine compartment. The engine can operate on regular leaded gasoline; durability testing has been on unleaded gasoline to simulate fuel anticipated in the United States in 1975.

The effects on vehicle performance of the CVCC system are small. There is a slight loss in power for the same engine displacement due to leaner operation and decreased volumetric efficiency. Fuel economy is essentially unchanged. There are no driveability penalties.

Development of the Honda CVCC engine to achieve lower NO_x emissions is continuing. The effects of EGR and modifications to the basic combustion process are being examined.

3.10 Effect of Emission-Control Devices on Vehicle Performance, Driveability, Fuel Economy, and Safety

Some of the emission-control devices and techniques required to meet the 1976 emission standards have a profound effect on at least three areas of vehicle performance: acceleration capability, fuel economy, and driveability. There is also some concern that poor performance of such cars will make them unsafe in certain circumstances, for example, if the vehicle stalls when accelerating into fast-moving

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traffic. The customer is sensitive to these characteristics which affect both his pocketbook and his attitude toward any particular vehicle. Traditionally this area has been one in which customer complaints and warranty returns have been especially prevalent. It is therefore not surprising that manufacturers have registered great concern in the past about the adverse effects of emission control devices. By the same token, however, the market place imposes considerable inherent motivation for manufacturers to devote great attention to product improvement in these areas.

The comments that follow in this section refer primarily to vehicles equipped with the dual-catalyst emission-control system.

In general, vehicle acceleration capability is reduced by control measures applied for control of all three pollutants (HC, CO, and NO_x); however, NO_x control measures which reduce combustion temperature have the most serious deleterious effects. Reductions in compression ratio to enable use of lower-octane gasoline resulted in acceleration penalties, as did the minimization of enrichment techniques formerly provided specifically for rapid acceleration capability. In addition, the use of EGR to reduce combustion temperatures and thereby inhibit NO_x production imposes a severe acceleration penalty.

Losses in fuel economy accompany most of these losses in acceleration capability and are aggravated by countermeasures taken to overcome deficiencies in acceleration capability and driveability. Many of the smaller engines have been dropped in the various car lines. The use of a larger displacement engine results in a fuel economy penalty for both city and open-highway driving. When EGR is used to control NO_x emissions, the mixture must be enriched to retain adequate driveability, causing drastic reductions in fuel economy.

The most troublesome of numerous driveability problems is the cold-start problem. The quick choke action and subsequent lean mixtures required to minimize HC and CO emissions introduce problems with engine stalls and unsatisfactory drive-away during warm-up. EGR and spark retard cause such problems as lack of response, die-outs, and hesitation on acceleration.

In its January 1, 1972, report, the CMVE concluded that all three areas of vehicle performance discussed above would be adversely affected by the 1975 emission-control systems. Information received from manufacturers indicated losses in acceleration capability ranging from a minimum of 5 percent to a maximum of 20 percent over 1971 levels. All manufacturers anticipated losses in driveability, in some cases indicated to be severe. Anticipated increases in fuel consumption ranged from 5 to 15 percent for standard sized cars up to 20 to 30 percent for small cars, again over 1971 levels. Much of the deterioration in performance was anticipated to come with the introduction of NO_x requirements in 1973, and early reports on performance of the new models have confirmed this.

During 1972, the CMVE has received reports on both the 1975 and 1976 emission-control system progress. While manufacturers are still concerned with performance, particularly fuel consumption, the concern over vehicle driveability has diminished.

No substantial new acceleration, fuel economy, or driveability problems are introduced with the 1976 emission-control systems compared with the 1975 systems. At the same time, considerable progress has been made in finding solutions to problems that appeared to be very serious one year ago. It seems likely that competitive pressures will result in further improvements and improved reliability in these performance areas. The effort required is essentially engineering development based on extensive field experience with these new systems. The major long-term concern should be the continuing fuel economy penalty which results from the decreased compression ratio to allow the use of unleaded fuels, compounded by the use of EGR to control NO_x emissions to very low levels, and aggravated by the increased engine sizes introduced to compensate for the loss in performance.

3.11 Alternative Fuels

One approach to reduce emissions from conventional engines is the use of alternative fuels. The use of liquefied natural gas (LNG), liquefied petroleum gas (LPG), hydrogen, and alcohols have been considered by the Committee.

3.11.1 Liquefied Natural Gas and Liquefied Petroleum Gas

Both industry and governmental groups have evaluated natural gas and propane (LPG) to determine their capability in reducing emissions from automobiles. One engine manufacturer showed that emission levels approaching the 1975-76 standards can be achieved, but exhaust gas recirculation is still required to reduce NO_x formation to the 1975-76 standard. There is an 8 percent loss in peak engine power (350 cu. in. 1970 engine) from gasoline when using LPG and a 15 percent loss using natural gas. There is a substantial loss in fuel economy (30 percent), and driveability is impaired. The use of LPG for starting and warm-up in a dual-fuel car using gasoline for conventional operation was attempted. Cold-start emissions are decreased.

On an experimental natural-gas 6-cylinder engine sized for bus operation, another manufacturer showed that the use of compressed or liquefied natural gas would produce emissions which would meet 1975 standards. The 1976 NO_x standard could be met only with EGR, a catalytic after-burner, and a great reduction in performance. The emissions were odorless and there was no particulate matter present.

There are over 5,000 cars converted to run on gaseous fuels in the Los Angeles basin where gas supplies and liquid systems have been joined together to provide the gaseous fuels to the car operators. Emissions are cleaner, maintenance is reduced, but a heavy bulky tank is required to hold the gaseous fuel.

3.11.2 Status of Liquefied-Gas Substitutes for Gasoline

The CMVE has investigated the technical problems and economic factors involved in supplying natural gas and LPG. It is possible to modify the petroleum refining process so that LPG can be substituted for gasoline for motor vehicles. The original capital costs would be in the $50 billion range. The fuel costs to the customer would be about twice as much as gasoline presently costs. Also, there is a serious net loss of energy in changing from gasoline to LPG. The percentage of crude oil consumed in the processing operations would increase from about 4 percent to about 14 percent. This would be an unrecoverable waste of natural resources.

There is not enough LPG, LNG, or Synthetic Natural Gas (SNG) currently available to be significant if conversion were desired now. A three-year lead-time for making changes for supplying these alternative fuels is a minimum.

3.11.3 Hydrogen

Hydrogen gas has three properties which, when taken together, give it a unique potential as a vehicular fuel. First, since there is no carbon in the fuel, the problems of unburned hydrocarbons and of carbon monoxide do not exist. No after-burner, catalyst, or other secondary reaction vessels are needed.

Second, the flammability limits of hydrogen are extremely wide. The volume percentage of hydrogen in air can range over a factor of 19 and still be ignited by a spark. This contrasts with the factor of 5 for gasoline vapor. Because of this high flammability range, very lean mixtures of hydrogen gas may be used, thereby insuring that NO_x will stay within acceptable standards. With hydrogen as a fuel, no EGR is needed to reduce NO_x.

Third, the supply of hydrogen gas is virtually inexhaustible, although plants for its mass production are not yet available. Currently, the cheapest way of making hydrogen gas is to use natural gas as a base material. When natural gas approaches exhaustion, the cheapest way of making hydrogen gas will be to use coal as the base material. When the price of coal becomes too high, hydrogen can be made by heating or electrolyzing water. A source of energy is required to produce hydrogen by any of these methods.

An engine burning hydrogen gas at stoichiometric ratio emits no measurable hydrocarbons, organic or sulfur compounds, and only one-tenth the NO_x as when burning gasoline vapor at its stoichiometric ratio. Furthermore, at an air-fuel ratio of 1.75 times stoichiometric, the NO_x composition of the hydrogen exhaust is reduced by a further factor of 20, well below the 1976 standards. Several experimenters have reported satisfactory performance from internal combustion engines converted to hydrogen fuel.

The cryogenic fuel tank plus its hydrogen fuel would weigh 40 percent less than the conventional tank plus its gasoline having the same cruising radius, but would occupy five times the volume. Other storage methods are being sought.

One company is attempting to produce H_2 and CO_2 from unleaded gasoline in the car gas tank using a small reformer located in the trunk of the car. The H_2 and CO_2, produced in small quantities to avoid safety problems, could be burned cleanly in the slightly modified

Otto-cycle engine. Questions remain on the ability of the reformer to carry out this reaction and on its efficiency, size and cost. Sound experimental work and socio-economic impact studies on the use of hydrogen as a vehicular fuel are required before unqualified success could be claimed for the approach. In any case large-scale use of hydrogen as an automotive fuel is not possible by 1976.

3.11.4 Alcohols

Alcohol has been proposed and used as a fuel for the internal-combustion engine; e.g., methyl alcohol is widely used as a racing fuel. Methanol has the advantage of providing a lower combustion temperature, reducing the NO_x emissions, and it also has lower lean misfire limits than gasoline, thus reducing HC, CO, and NO_x emissions while maintaining a satisfactory driveability. Emissions tests have been run on a 1970 American Motors Gremlin, using pure methanol as fuel, with a platinum catalyst converter in the exhaust. Emissions of HC, CO, and NO_x, using the 1972 CVS Federal Test Procedure, were below the 1976 standards.

Methanol has a lower heating value than gasoline, so yields correspondingly fewer miles per gallon. Starting at low temperatures with methanol is a problem; volatile compounds have to be added to assure smooth starting.

Similar data on ethanol are not available. Tests on gasoline with up to 30 percent ethanol as fuel show no substantial improvement in emissions over pure gasoline.

4. POTENTIAL OF SPARK-IGNITION INTERNAL-COMBUSTION ENGINES FOR MEETING STANDARDS IN USE

4.1 Introduction

Section 3 presented an evaluation of the feasibility of spark-ignition internal-combustion engines passing the certification test for 1975 and 1976. This section assesses the feasibility of such engines continuing to meet the standards in customers' hands.

In this assessment, the first question to be answered is the adequacy of the certification test to evaluate the emissions performance of vehicles in customers' hands. The next question is the maintenance required on prospective 1975-76 control systems to achieve compliance in use. This calls for discussion of the procedures necessary to ensure proper maintenance, namely the nature and feasibility of required testing and maintenance. The latter depends in turn on the adequacy of the service industry and the interest of state governmental bodies enacting required legislation. Perhaps the overriding question is whether adequate consideration has been given to maintenance in the design of planned 1976 emission-control systems, most of which involve the use of catalytic converters.

4.2 Differences between Certification Test and In-Use Operation

It is relevant to discuss here some of the more significant differences between the stresses on the emission-control system experienced during certification and during normal customer operation. The driving modes specified in the mileage-accumulation schedule of the certification procedure do not represent all the possible modes encountered in real life. There are some not included, such as sustained operation at high engine power and long decelerations, that will provide severe tests for emission-control systems, especially those using catalytic converters. Ford believes the certification test driving does not provide enough mechanical stress on the catalyst, especially if the driving is carried out on an automatically operated dynamometer, which is the usual procedure for the accumulation of mileage. The vehicles are stopped only for tests every 4,000 miles; in normal use, of course, vehicles stop much more frequently. With catalytic systems, catalysts will heat up and cool down several hundred more times in 50,000 miles of normal use than in certification. The New York City Department of Air Resources has also pointed out that the certification procedure does not represent actual driving conditions because of insufficient allowance for the effect of accessories.

Sufficient data are not available to fully assess the effects of low-temperature operation on catalyst durability. However, increased loading on the catalysts due to low ambient temperatures, as well as occasional bouts of freezing and thawing, appear to offer in-use conditions that would lead to the necessity for more frequent catalyst replacement than during the certification procedure.

The durability phase of the certification test should be sufficiently demanding to establish that the emission-control systems will perform in the hands of customers. The allowable maintenance in the durability test - one major tuneup in 50,000 miles - was selected to make the test tough and realistic. In real life, much more frequent maintenance will probably be necessary to keep 1975-1976 systems within the specified emissions levels, and the Act (Section 207(c)(3)) requires the manufacturers to furnish written maintenance instructions with each new vehicle. Manufacturers are in agreement that more maintenance than is allowed in the certification test will be necessary in actual use. This is supported by the fact that manufacturers are now requiring more maintenance as a condition of warranty than they were allowed in the certification procedure.

In summary, the Committee recognizes that vehicles in customers' hands will not be driven according to the CVS-1975 test procedure, will not be driven according to the durability driving schedule, and will not receive the maintenance specified by the manufacturer without rigid enforcement procedures. Therefore, stresses on the systems may be substantially greater in customer usage than in certification, and in-use emission levels may thus be correspondingly higher.

4.3 Maintenance Procedures Required for 1975-76 Systems

Although there are no data on the deterioration of the projected 1975-76 control systems in customer use, there are data on the typical deterioration of emission levels from the cars now being driven. These data provide some limited indication of the deterioration as a function of mileage that can be expected to occur with the new systems. Information provided by EPA, California, and ARCO on 1971 and prior model year cars indicates a substantial increase in emissions in customer use. Emissions were found to exceed the applicable standards at relatively low mileage.

The most comprehensive surveillance data on the emissions of cars in use have been taken by the California Air Resources Board. Data taken between January and March 1972 showed that 1970 model year cars, with an average accumulation of 32,000 miles, exceed the applicable California standards for all three pollutants by amounts ranging from 10 to 60 percent. 1971 model year cars, with an average mileage accumulation of only 13,000 miles, exceeded the applicable standards for at least one of the pollutants. Cars for these model years contain neither catalysts nor much of the other complex hardware proposed by most manufacturers for 1975-76 model years. Further, the applicable standards for California for these model years are many times higher than the federal standards for 1975 and 1976.

The dual-catalyst emission-control system proposed by most manufacturers for 1976 model year vehicles is a far more complex system than that used on current vehicles. Involved are a multitude of control valves, quick-warm-up systems, control circuits, etc., as shown in Figure 3-1. Of all these components, the catalysts themselves appear to be the least durable items. Spark plug misfire, sustained operation at high engine power, and descent down long hills are examples of situations that would result in catalyst overheating and possible failure. Such vehicle operation and driving modes would not occur in the mileage accumulation specified for the certification test.

In addition, there appears to be little incentive for the car owner to maintain the emission-control system. To the contrary, the engine will run more efficiently and smoothly with some elements of the emission-control system inoperative. For example, plugging of the EGR system would improve gas mileage, although also increase NO_x emissions. Increase of choking time would improve vehicle starting characteristics, yet also increase cold-start emissions.

The importance of adequate maintenance is recognized in Section 207(b)(2)(A) of the Clean Air Act, which requires manufacturers to warrant their emission-control systems to the purchaser if the vehicle or engine is maintained and operated in accordance with the manufacturer's instructions, and, in the recall provisions of Section 207(c)(1), which empowers the Administrator to recall a class of vehicles or engines if a substantial number of vehicles in each class, although properly maintained and used, do not conform with the standards. The recall provisions could be enforced by relatively frequent analysis of emissions from a sample fleet, carefully chosen for appropriate statistical representation. Should these give evidence of rapid deterioration of the control system, the recall power provided by Section 207(c) of the Act may then be invoked, with the manufacturer specifically enjoined to replace defective parts, and to defray the associated labor costs at his expense. In this situation, the burden falls not only on the manufacturer for recall and repair, but also on the car owner, for performing the required routine maintenance and for responding to notifications of recall.

In order to achieve the reduction in automotive emissions anticipated by the Clean Air Act, it is apparent that methods must be provided for ensuring proper maintenance of the 1975 and 1976 emission-control systems in public use. Methods of ensuring the required maintenance include:

1. Requiring the service industry to adjust each car to manufacturer's specifications when performing any maintenance.

2. Periodically testing all cars and designating for adjustment or repair those not meeting pre-selected standards.

3. Periodically subjecting all cars to adjustment or repair.

The first method is based on the probability that the manufacturer's specifications for 1975-76 vehicles will represent adjustment to minimum emissions. Mechanics currently adjust cars for high performance. If they continue to do this when manufacturers' specifications are for low-emission adjustments, the cars will emit above the standards.

The principal variations in the second method are related to how much of the work is done in state-owned and how much in privately owned facilities, the testing procedure used, testing frequency, pass/fail standards, provision for retesting after repair/adjustment, and disposition of vehicles that cannot meet the standards.

The significant variations in the third method are related to whether the cars are adjusted to some pre-selected standards and whether preventive maintenance is included. Preventive maintenance may be the best feature of this method. Other methods for ensuring the maintenance of cars in use are probably feasible only if engineering changes, which do not seem likely by 1976, are made. They are:

4. Repair at the time of failure of any important emission-control device based on the presence of devices that signal the failure not only to the driver but also to the traffic officer.

5. Repair at the time of failure of any important emission-control device based on the manufacture of control systems that noticeably degrade the vehicle performance when an important component fails.

6. Prescribed maintenance at predetermined intervals. This method would require strict quality control of the manufacturing process so that essentially every car was held to a configuration proved to give low emissions in actual use.

4.4 Adequacy of the Service Industry

4.4.1 Training

The service industry at the present time is not adequate to service 1975-76 cars from an emission control standpoint. Knowledge of the devices, the diagnostic equipment, and the number of mechanics are inadequate. The number of vehicles per mechanic in the country has risen from 75 in 1950 to 145 in 1970. During the same time, cars have become more complex and less repair-oriented in design. The states that have studied the problem all feel that training on emission-control devices is needed and that the states should be responsible for recommending suitable equipment. New York plans to certify garages as properly equipped for emission-control work. California licenses mechanics, and New Jersey will depend on the promise of large-volume business to motivate the private sector to establish its own training and licensing programs. The service-industry mechanic will have to be trained to understand and perform repairs and adjustments whether or not he performs the complete or partial diagnosis to isolate problems causing excessive emissions. The amount of training will vary slightly with the degree of state control on mechanics, but will generally have to be extensive.

4.4.2 Number of Mechanics

The number of mechanics required to maintain 1975-76 emission-control systems will depend upon the interpretation of the 50,000-mile warranty provision of the 1970 Clean Air Amendments. If the new-car dealerships assume the responsibility and owners are required to bring their cars into the dealers' garages for periodic inspection and maintenance, a new force of about 12,000 mechanics per year will need to be trained for the dealers, on the assumption that 1975-76 control systems will require about two hours more per year than now spent to perform routine inspection and maintenance. This number of men will need to be added each year for about five years if new-car dealers maintain new cars during warranties: i.e., a new work force of about 60,000 men will be needed by 1980. When warranties expire, experience has shown that most owners will take their cars to garages other than new car dealers; hence, after 1980, an indefinite number of additional mechanics in garages other than new car dealers will need to be trained. The number of mechanics needed in the service industry is difficult to estimate because most of them will probably work only part time on emission control.

California is the only state that licenses mechanics to install and repair emission-control devices at this time. Only a few other states have plans to license mechanics. A Northrop study for the State of California and a similar study by the State of New Jersey have shown that a simple indoctrination of mechanics is not sufficient to obtain cost-effective emission tune-ups.

4.4.3 Equipment

The garages in the service industry will need to be significantly upgraded with new equipment to perform diagnoses and tests to determine if vehicles need adjustment or repair and to show that the adjustments and repairs were accomplished. The amount of equipment needed will depend partially on whether or not the state operates inspection stations and what kind of inspection test the state performs. However, the state inspection system that would significantly reduce service-industry equipment requirements would be one in which the state would perform the complete diagnosis and instruct mechanics on what parts to replace.

4.5 State Action

4.5.1 Inspection and Maintenance Systems

State governments have been interested in inspection and maintenance of motor vehicles as a means of reducing exhaust emissions for many years. For example, the New Jersey system, put in operation on July 5, 1972, is the outgrowth of an investigation that started in 1966. It should be noted that even in the New Jersey system, which is the farthest advanced, the features of compulsory maintenance will not be instituted until July 5, 1973. The first year of inspections is being used only to educate the public and eliminate the difficulties.

California has required a certificate of compliance from licensed installation stations since PCV valves were first required in 1963. Idle-exhaust measurement for HC and CO is also now done as part of California's roadside safety inspection. Cars exceeding inspection standards must be taken to a licensed mechanic for adjustment, and a notice that the work was done must be returned by mail.

This interest in inspection/maintenance systems undoubtedly arose from the knowledge that a well-maintained car emits less pollutants. A large impetus toward such systems has been added by the realization that the manufacture of cars meeting the 1975 and 1976 federal standards is not sufficient unless some system can be found to keep the complicated emission-control devices operating properly.

A survey of the present status of the state efforts to establish inspection/maintenance systems and an investigation of the reasons for the long-time delay in even the most active programs are, therefore, relevant parts of the Committee's investigation of methods of ensuring that the 1975-1976 cars meet the federal standards in actual use.

Certain federal action or lack thereof has had a noticeable effect on state action in this field. The Clean Air Act generally preempted motor vehicle emission control for the federal government. This raised several problems connected with the design of state systems. The first is a tendency toward delay; in the few cases in which a state had already started the design, revision was necessary and the states which had not started tended to wait for federal action.

Also pertinent are Sections 110 and 207 of the Clean Air Act. Section 110 requires the states to submit a plan for the implementation of the national ambient-air quality standards, and Section 207, deals specifically with motor vehicle compliance. Under the latter, once EPA determines that adequate inspection procedures are available, they are to be established by regulation. Since implementation plans are not yet final for all the states, and since the determination called for by 207(b) has not been made, resulting uncertainty inevitably leads to delays in program planning by the states.

The selection of the most suitable method for a state system depends not only on the engineering approach finally adopted by the manufacturers and on the test procedure designated by EPA, but also on whether the method is to be used only to minimize emissions or also to enforce the warranty on individual vehicles.

If the purpose is only to minimize emissions, periodic repair/adjustment of all cars including preventive maintenance is a possible choice. This approach would require no special inspection facilities owned by the state, but it would require careful surveillance of privately owned garages and additional equipment in these garages.

Requiring the garages to adjust each car to manufacturer's specifications when performing any maintenance also does not require state-owned facilities but does require close supervision. Preventive maintenance could be part of this method and, with this addition, this method only differs from the one first discussed by being voluntary instead of mandatory.

Periodic inspection of all cars with measurement of the exhaust emissions and compulsory adjustment or repair of those cars that have emissions exceeding pre-set standards is the method usually meant by an inspection/maintenance system. However, tests other than emissions measurements can be used for inspection in this method. It is normally thought of as occurring annually at the time of license renewal. This system can be operated on three bases: inspection and repair/adjustment in state facilities, inspection in state facilities and repair/adjustment in privately owned garages, and inspection and repair/adjustment in privately owned garages licensed or franchised by the state. The second of the three choices is the usual one principally because of the public distrust of the service industry, which causes the public to prefer inspection by the state. The first one is not chosen because of the reluctance of the state to compete with private enterprise and because of the many complications connected with building state-owned repair facilities.

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If the method selected must also include enforcement of the individual car warranty, it will be built around a test yet to be specified by EPA. It is usually assumed that this will be some type of short emissions test, but Section 207(b) of the Act would allow the Administrator to decide that functional tests on the components correlated reasonably well with the results of the CVS-CH test. It is conceivable that these tests could be done in privately owned facilities, but the quasi-official nature of the warranty test and its consequences make a state-owned inspection lane the more obvious choice.

If the method includes enforcement of the warranty, EPA will provide the appropriate test; if not, there is wide latitude. Diagnostic tests will be part of any system, since such tests and repair/adjustment cannot be separated, and repair by mechanics is the only operation that provides a direct emission reduction. Inspection lanes select the vehicles needing adjustment or repair but otherwise do nothing to reduce emissions unless the results assist or control the mechanics making the repairs. Inspection lanes can assist and control the mechanics in one or more of the following ways:

1. Detect vehicles with excessive emissions (needing repairs).

2. Detect vehicles with excessive emissions and give a partial diagnosis to help the mechanics get started.

3. Provide a complete diagnosis of repairs needed on vehicles with excessive emissions; and

4. Insure that repairs are complete and correct.

A study by Northrop Corporation for the State of California found that a schedule of diagnostic tests was not a cost-effective approach to the emission control of used cars. The study showed that exhaust-emission tests by a short dynamometer test (Key Mode) or an idle test gave partial diagnostic information and was more cost-effective. Partial diagnostic information was given to the repair mechanic to assist him in the final diagnosis.

The Key Mode and idle approach were reasonably effective for correcting the major emissions problems in used cars. They may not be adequate for controlling 1975-1976 cars to much lower emission levels because there is not yet available a short test that is precise enough to give a pass or fail that is meaningful in terms of meeting 1975-1976 standards. 1975-1976 cars will require a much more thorough diagnosis of the complete emission control system.

Diagnostic tests could be useful in inspection lanes if they provided complete information on engine and control-system failures and operation. This could be accomplished by an automatic and computerized diagnostic console, programmed to accomplish quickly and inexpensively one or both of the following:

1. Functional tests showing that the engine and/or the control system are not within specifications where it is known that the combined system will meet the standards.

2. Diagnostic tests showing what parts need to be checked and/or replaced.

The mechanics in the service industry could be trained to understand and use the information supplied by the inspection-lane diagnoses.

4.5.2 Diagnostic Tests at Garages

The facilities and equipment of garages can be upgraded to perform diagnostic tests at periodic intervals. The advantage of this approach is that the mechanics accomplishing the repairs would have first-hand knowledge of the diagnostic test results. Disadvantages of this approach for 1976 vehicles are:

1. Functional NO_x catalyst activity tests and NO_x analyzers have not yet been developed to diagnose NO_x controls. It may be possible to check the activity of a reduction catalyst in the oxidizing mode.

2. The engines may need to be loaded in order to produce enough NO_x for a meaningful test.

4.5.3 Selection of Repair/Adjustment Standards

Since the object of an inspection/maintenance system is to reduce the total amount of pollutants emitted to the atmosphere, there is a strong incentive to require repair and adjustment for a high percentage of the cars found to be over standards. However, as more and more cars are adjusted/repaired, the gain in air quality per dollar spent decreases; i.e., the cost effectiveness decreases. With practical and cost considerations thus limiting the number of cars sent for adjustment and repair, the maximum emissions reduction is to be achieved by adjusting only those cars whose emissions are clearly high and leaving alone those below or near the satisfactory level.

The percentage of cars sent for adjustment/repair must be considered with great care also because it increases the load on both the service industry and the inspection lanes and because a high percentage of re-rejections will destroy public support, which is so important.

With the present state of the service industry, a sizable percentage of cars will not meet the standards after the first repair/adjustment if the levels are strict. In addition there is a shortage of mechanics of even reasonable training. If the standards are set to send a high percentage of cars for repair/adjustment, the number of cars that cannot meet the standards without costly repairs will be so large that it will again affect public support.

4.5.4 Timing and Cost of Inspection Facilities

The time and cost required to set up inspection facilities depends to a large extent on the amount and type of related facilities that are already available. Three cases will be considered:

1. Safety-inspection facilities are already available and emissions testing can be added to such facilities.

2. Properly controlled, privately owned service facilities are available, with emissions testing done at such facilities.

3. Neither condition 1 or condition 2 exists and inspection facilities must be built.

New Jersey is an example of the first situation and it has proved relatively easy from a physical standpoint to add emissions testing to the state-owned safety-inspection lanes. For the idle test that they are using, equipment costs are about $2,000 per lane. On the assumption that legislative authority already exists, it should be possible to put emissions testing in operation in one year. Extra manpower required would be one per lane. No meaningful estimate of operating or capital costs chargeable to the emissions testing is possible because of shared costs. Time and cost would both increase if the testing were also intended to enforce the federal individual car warranty.

California could be an example of the second situation since they license Grade A mechanics for various specialties including emission-control devices. The time required in this case should also not exceed one year. Costs for added equipment would again be about \$2,000 per station for an idle test. Operating costs would be mixed with adjustment and repair costs and, consequently, a separate estimate is probably of questionable meaning.

The third situation has been studied in considerable detail by Northrop-Olson Laboratories and also by TRW. Because of the conditions assumed in this study, the cost results must be qualified although the results do give a good indication of the range to be expected. The land, structure, and equipment will cost from \$23,000 to \$60,000 per inspection lane, with a major portion of the difference in cost caused by the presence or absence of dynamometer equipment. These numbers are approximately confirmed by the TRW study which estimated \$44,000 to \$52,000 per lane for dynamometer-equipped facilities. Different tests not only use different equipment but they also have different throughputs per lane.

Based on these factors, the cost of land, structure, and equipment on a one-inspection-per-year basis is between \$1.30 and \$8.80 per car when calculated for California's population distribution and 10 million cars.

Operating costs in 1976 would be between \$1.20 and \$4.00 per car per year, again under California conditions. The original capital costs are a small fraction of this and they are included with structures amortized over 20 years and equipment over 5 to 10 years.

Training time for personnel would be between 90 and 180 hours per man, which includes 40 hours classroom training.

Again on the assumption that legislative authority already existed, it would probably take 1.5 to 2 years to acquire land, erect and equip the buildings, and train personnel. At least one year must be added to any of the above time schedules if legislative authority does not already exist. Even more time must be added if an operational plan does not exist; witness the New Jersey and New York experiences. A state just starting would probably be fortunate to have a fully operational inspection system in 4 years.

In summary, only few states have any semblance of a testing/inspection system that would be adequate to ensure compliance in use. Most states do not even have plans for such systems. The present service industry is inadequate to maintain the complex emission-control hardware called for with the dual-catalyst system planned for use in 1975-76. With this pessimistic appraisal of feasibility, it is well to consider alternate approaches.

4.6 Incorporation of Maintenance Considerations in Emission-Control System Design

The pessimistic appraisal of the feasibility of vehicles equipped with dual-catalyst control systems meeting the standards in customer use is indicative of a lack of consideration of maintenance in the design of such systems. From the data presented in Section 3, it appears that several systems offer maintenance advantages over the dual-catalyst system, although the low-mileage emissions of such systems, on experimental vehicles, may not currently be as low as those of the dual-catalyst system.

The three-valve carbureted stratified-charge engine and the Wankel engine with thermal reactor show potential for low emissions without the use of catalysts. HC and CO deterioration factors for the former, at 1975 levels and as measured on the federal driving cycle, are considerably less than those from catalyst-equipped vehicles.

Development work is required on the engine to reduce NO_x emissions to 0.4 grams per mile; however, such a development effort would seem well worthwhile due to the potential of the engine for reduced maintenance and improved performance in use over the dual-catalyst system.

Systems employing precise control of air-fuel ratio with a feedback loop, discussed in Section 3.6, have several possible maintenance advantages. Since an air-fuel ratio near stoichiometry results in almost optimum performance, the serious performance and fuel penalties inherent in other NO_x-control methods would be eliminated; the advantage, from the owner's viewpoint, of an inoperative control system would be removed. In fact, any malfunction of this system might easily degrade vehicle performance so that the owner would be encouraged to get the emission-control system fixed.

Since such a feedback loop makes the engine essentially self-tuning, this approach should also eliminate a large fraction of the inherent variability between individual vehicles that results from manufacturing tolerances. Possibly also, operational variabilities that result from variations in driving habits, fuel consumption, atmospheric parameters, and induction-system deterioration would be largely eliminated. Thus a larger fraction of cars would operate as designed and emit less pollutants.

Excessive catalyst temperature caused by the simultaneous presence of excess oxygen and large amounts of combustibles would be eliminated since neither rich mixtures nor secondary air is required. Finally, since the system includes an electronic control circuit, installation of signals for malfunctions should be relatively easy.

4.7 Summary

Emissions of 1975-76 vehicles in customer usage can be expected to be greater than those measured during certification. Because of the added emission controls, most vehicle configurations proposed for these years will require more maintenance than at present. For all systems, some additional inspection and maintenance will be necessary to assure that the vehicles are meeting standards in use. Some legal enforcement procedures will be required to assure that necessary inspection and maintenance are performed; otherwise, vehicles will very likely exceed the emission standards in use.

The service industry at the present time is not adequate to service the 1975-76 cars from an emissions standpoint. Only few states have a semblance of a testing/inspection system for emissions that would be adequate to ensure compliance in use.

A basic problem in establishing technological feasibility is that maintenance considerations have not been given adequate attention in design. The three-valve carbureted stratified-charge engine, Wankel with thermal reactor, and catalytic system with exhaust sensors and feedback control seem to have far more potential for achieving low emissions in use than the dual-catalyst system currently being proposed by most manufacturers for the 1976 model year.

5. MANUFACTURING, COSTS, AND PRODUCIBILITY

Manufacturing plans of the major automobile companies for 1975-1976 systems are not firm at this stage. Changes will almost certainly be made between now and the start of production. However, each company has taken positive steps toward implementation of their best estimate of the components that might be introduced for 1975 and 1976. Schedules are compressed and significant risks are involved. Consequently most companies have more than one alternative plan for the emission-control system for these model years. In some cases, manufacturers have designed and/or made tooling for alternative configurations.

5.1 Manufacturability of Several Proposed Engine Systems

Several types of engines that might be produced in the 1976 model year have been evaluated from the view point of manufacturability and costs. These engines are: 1) the dual-catalyst system proposed by most manufacturers, 2) the diesel, 3) the Wankel, 4) the three-valve stratified-charge, and 5) a feedback-controlled system with electronic fuel injection and a three-way catalyst.

5.1.1 The Dual-Catalyst System

In response to California and federal regulations over the years, the automotive industry has progressively added to the emissions-control devices on automobiles. Due in part to a determined effort to preserve as much of the technology of the carbureted internal-combustion engine as possible, the approaches to emissions control have consisted of add-ons and relatively minor engine modifications. Although the various companies have worked independently, there have been many similarities in approach, and the typical pattern of hardware addition is presented in Table 5-1. Beginning with the 1976 model year, this

Table 5-1

Chronology of Development of the Dual-Catalyst System

Model Year		Emission Hardware Added
1966	a)	PCV Valve
1968	a)	Fuel-Evaporation Control System
1970	a)	Retarded Ignition Timing
	b)	Decreased Compression Ratio
	c)	Increased Air/Fuel Ratio
	d)	Transmission-Control System
1972	a)	Anti-Diesel Solenoid Valve
	b)	Thermostatic Air Valve
	c)	Choke-heat Bypass
1973	a)	Exhaust-Gas Recirculation
	b)	Air-Injection Reactor
	c)	Induction-Hardened Valve Seats
	d)	Spark Advance Control
	e)	Air Pump
1974	a)	Precision Cams, Bores, and Pistons
Model Year		**Emission Hardware-Likely Configurati**
1975	a)	Proportional Exhaust-Gas Recirculati
	b)	Carburetor with Altitude Compensatio
	c)	Air/Fuel Preheater
	d)	Electric Choke
	e)	Electronic Ignition
	f)	Improved Timing Control
	g)	Oxidizing Catalytic Converter
	h)	Pellet Charge
	i)	Increased Cooling System
	j)	Improved Underhood Materials
	k)	Body Revisions
Model Year		**Most Common Configuration**
1976	a)	NO_x Catalytic Converter, 2 required
	b)	Electronic Emissions Control
	c)	Sensors

system will include both oxidation and reduction catalysts; thus it is termed the dual-catalyst system. This system is shown schematically in Figure 3-1.

The corresponding increases in sticker price associated with these hardware additions are detailed in Table 5-2 and summarized in Table 5-3. According to these estimates, the additional price increase of 1976 models over those of 1975 is about $134.00, or nearly the same as the increment for the preceding year.

At this time it still appears possible for the manufacturers to mass-produce systems similar to that shown in Figure 3-1 for their 1976 models. However, until the systems show more likelihood of meeting certification for 1976, the manufacturers are reluctant to make major commitments, particularly for catalysts, and much more delay will make these systems technologically impossible for 1976 because of insufficient lead time. If this type of system is to be mass-produced in the 1976 model year, the following must have been accomplished by mid-1973:

- Freeze design for production
- Build catalytic converter plant and line
- Commit to plant and equipment for substrate
- Commit to new carburetor production design
- Freeze design of early fuel-evaporation system

5.1.2 Diesel Engine

Some light-weight diesels are currently being produced for passenger cars, mainly in Europe and Japan. However, because it is difficult to make a diesel engine meet the 1976 NO_x standards, and, for other reasons discussed in Section 6.1, there is no serious effort to develop the diesel engine for large-scale mass-production as a passenger-car engine. If diesel engines are developed to meet the

TABLE 5-2

Estimates of Sticker Prices for Emissions Hardware from 1966 Uncontrolled Vehicle to 1976 Dual-Catalyst System*

Model Year	Configuration	Value Added [1]	Tooling Amort. [2]	Dealer Margin [3]	Profit [4]	List Price	Excise Tax [5]	Sticker Price
				TYPICAL EMISSIONS HARDWARE				
1966	PCV-Crank Case	1.90	-	.66	.29	2.85	.15	3.00
1968	Fuel Evaporation System	9.07	.45	3.30	1.43	14.25	.75	15.00
1970	Carburetor A/F Ratio	.61	.02	.22	.10	.95	.05	1.00
	Compression Ratio	1.24	.03	.44	.19	1.90	.10	2.00
	Ignition Timing	.61	.02	.22	.10	.95	.05	1.00
	Transmission Control System	2.49	.05	.88	.38	3.80	.20	4.00
						Total 1970		8.00
1971 1972	Anti-Dieseling Solenoid	3.07	.10	1.10	.48	4.75	.25	5.00
	Thermo Air Valve	2.49	.05	.88	.38	3.80	.20	4.00
	Choke Heat By-pass	2.74	.05	.97	.42	4.18	.22	4.40
	(Assembly Line Tests Calif) (1/10 Volume)	.18	.20	.13	.06	.57	.03	.60
						Total 1971-72		14.00

TABLE 5-2 (Cont'd)

Model Year	Configuration	Value Added[1]	Tooling Amort.[2]	Dealer Margin[3]	Profit[4]	List Price	Excise Tax[5]	Sticker Price
1973	OSAC (Spark Adv. Control)	.48	.15	.22	.10	.95	.05	1.00
	Transmission Changes (Some Models)	.63	-	.22	.10	.95	.05	1.00
	Induction Hardened Valve Seats (4 and 6 cyl.)	.72	.55	.44	.19	1.90	.10	2.00
	EGR (11-14%) Exhaust Recirculation	5.48	.87	2.20	.95	9.50	.50	10.00
	Air Pump--Air Injection System	27.16	1.80	10.03	4.33	43.32	2.28	45.60
	(Quality Audit Assembly Line) (1/10 Vol.)	.23	.02	.09	.04	.38	.02	.40
						Total 1973		60.00
1974	Induction Hardened Valve Seat V-8	.72	.55	.44	.19	1.90	.10	2.00
	Some Proportional EGR (1/10 Vol. @ $52.)	3.21	.10	1.14	.49	4.94	.26	5.20
	Precision Cams, Bores, and Pistons	2.44	.10	.88	.38	3.80	.20	4.00
	Pretest Engines -- Emissions	1.80	.10	.66	.29	2.85	.15	3.00
	(Calif. Catalytic Converter System - 1/10 Vol. $64.)	4.02	.04	1.41	.61	6.08	.32	6.40
						Total 1974		20.60

TABLE 5-2 (Cont'd)

Model Year	Configuration	Value Added[1]	Tooling Amort.[2]	Dealer Margin[3]	Profit[4]	List Price	Excise Tax[5]	Sticker Price
1975	**Proportional EGR (accel-decel)	20.07	-	6.95	3.00	30.02	1.58	31.60
	New Design Carburetor with Altitude Compensation	7.52	2.00	3.30	1.43	14.25	.75	15.00
	Hot Spot Intake Manifold	2.87	.30	1.10	.48	4.75	.25	5.00
	Electric Choke (element)	2.67	.50	1.10	.48	4.75	.25	5.00
	Electronic Distributor (pointless)	4.35	2.00	2.20	.95	9.50	.50	10.00
	New Timing Control	1.40	.50	.66	.29	2.85	.15	3.00
	Catalytic--Oxidizing-Converter	18.86	4.00	7.92	3.42	34.20	1.80	36.00
	Pellet Charge 6# @ $2.00/lb	12.00	1.72	4.75	2.05	20.52	1.08	21.60
	Cooling System Changes	1.17	.10	.44	.19	1.90	.10	2.00
	Underhood Temp. Materials	.63	-	.22	.10	.95	.05	1.00
	Body Revisions Welding Presses	.67	.60	.44	.19	1.90	.10	2.00
	Assembly Line Changes	.13	.50	.22	.10	.95	.05	1.00
	End of Line Test Go-No Go	1.85	.05	.66	.29	2.85	.15	3.00
	Quality Emission Test	1.22	.05	.44	.19	1.90	.10	2.00
						Total 1975		138.20

TABLE 5-2 (Cont'd)

Model Year	Configuration	Value Added [1]	Tooling Amort. [2]	Dealer Margin [3]	Profit [4]	List Price	Excise Tax [5]	Sticker Price
		1976 MOST COMMON CONFIGURATION						
1976	2 NO_x Catalytic Converters	22.00	2.76	8.58	3.71	37.05	1.95	39.00
		22.00	2.76	8.58	3.71	37.05	1.95	39.00
	Electronic Control	28.00	3.75	11.00	4.75	47.50	2.50	50.00
	Sensors	3.00	.81	1.32	.57	5.70	.30	6.00
						Total 1976		134.00

Notes to Figure

1. Either value added or hardware cost, including material, labor overhead and G & A.
2. Tooling and equipment amortized over three years.
3. As 22% of selling price.
4. As 10% of list price.
5. As 5% of sticker price.

Costs are the average for the various car sizes and production volume for each size.

*Estimates based on 1972 dollars

**Proportional EGR costs were adjusted based on recent data

TABLE 5-3

Summary of Sticker Prices for Emissions Hardware from 1966 Uncontrolled Vehicle to 1976 Dual-Catalyst System

Year	Sticker Price Increase	Cumulative Price
1966	$ 3.00	$ 3.00
1968	15.00	18.00
1970	8.00	26.00
1971-72	14.00	40.00
1973	60.00	100.00
1974	20.60	120.60
1975	138.20	258.80
1976	134.00	392.80

1972 Dollars

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1976 emission levels, the emission control will probably be largely achieved by engine modifications and possibly turbocharging. Thus, even though the exact configuration is undefined, the manufacturability would not differ greatly from that of current diesel engines, and the major manufacturing problems can be identified.

The engines themselves are quite similar to Otto-cycle piston engines, but necessarily heavier to withstand higher operating pressures. The transfer and assembly lines for these engines are similar to those used for existing gasoline engines. Fuel-injection pumps and injection nozzles are now being produced on very modern mass-production equipment in England and Germany. Turbochargers have been produced in low volume for larger engines, and adaptation to mass-production for smaller engines is quite feasible. Most of the technology for mass-production of light-weight diesel engines is available but scattered, mostly in Europe. This wide dispersion of technology is a major barrier to the coordinated development of a low-emission diesel engine.

In additon to changes in the engine and its auxilliaries, conversion of automobiles to diesel power would require relatively major modifications of the frame, suspension, and body in order to accommodate the larger, heavier engine. If a diesel engine that can meet the 1976 emission standards is developed, and if, as assumed here, it is generally similar to present diesel engines, it should be possible to mass-produce them for the 1976 model year if the following have been accomplished by mid-1973:

- Freeze design for production
- Arrange for transfer of European light-duty diesel technology
- Build low-volume production tooling
- Plan for conversion of gasoline engine lines for diesel engine production
- Plan body changes
- Arrange for supply of turbochargers (if used)

5.1.3 Wankel Engine

The Wankel engine is being mass-produced in Japan and sold in the United States at competitive prices. The engine is in mass-production in Japan at Toyo Kogyo with American sales of the Mazda in the United States projected at 350,000 units in 1975. A recent announcement indicates a production commitment to the Wankel engine by General Motors. There is every indication that a substantial number of Wankel-powered automobiles will be driven on United States roads in 1976.

The engine has a cost advantage due to its low weight per horsepower -- about 1.5 pounds per horsepower compared to 4 to 6 pounds for a piston-type gasoline engine. The manufacturing advantages of the Wankel engine are that it can be manufactured and assembled on fully automatic production lines. The engine design will eventually allow a new frame and body design that will have many safety, space, and weight advantages. The implementation plan for the General Motors Wankel engine has it introduced into the low end of the line, possibly replacing both the 4- and 6-cylinder engines in turn. The optimum-cost volume per year of the Wankel engine will be between 450,000 and 600,000 engines per year. The small V-8s might also find a larger-diameter 2-rotor Wankel engine as a competitor. A 4-rotor Wankel engine is a more complex design with longer crank shaft. Two to four more years will be required on its development before it can be considered a competitor to the larger V-8.

The manufacturing requirements for the Wankel engine are concentrated around the following significant equipment: a trochoid grinder for the rotor housing, a rotary grinder for finishing of the end housings, an eccentric grinder for the rotor, some special plating equipment combined with surface-preparation equipment, and special equipment for pressing and sintering the apex seals. These machines are available today from several machine-tool concerns and can be delivered within one or two years. Mass-production conversions of these will require between one and two years of tooling design. An automatic assembly line and machining line combined will probably take anywhere from three to five years to develop and install.

The cost of a future Wankel-powered car will be \$140.00 to \$800.00 less per car than the corresponding 1976 dual-catalyst configuration; of this amount, \$25.00 to \$77.00 is due to the engine, and the remainder of the saving would come from design of a lighter, shorter car.

5.1.4 The Carbureted Three-Valve Stratified-Charge Engine

Because the three-valve stratified-charge engine is basically an existing carbureted spark-ignition piston engine except for modifications to the cylinder head, carburetor, and manifolds, it presents relatively few production problems. Manufacture of all components is based on known and proven technology. Honda Motor Company plans to produce this type of system for their 1974 models in Japan, and they will introduce it in the United States in 1975. For another manufacturer to mass-produce this system in model year 1976 would require the following accomplishments by mid-1973:

- Transfer technology from Honda Motors
- Freeze design for production
- Decisions made and orders placed for new transfer lines for cylinder heads, manifold systems, and carburetors
- Design new camshaft-production line

5.1.5 A Typical Feedback-Controlled System

Because of the apparent potential for emission reduction and ease of maintenance, which might result with further development of some of the feedback-controlled systems, manufacturability and costs of one of these systems were evaluated. The configuration studied included electronic fuel injection and a three-way catalyst. As with the dual-catalyst system discussed in Section 5.1.1, this approach requires relatively minor changes to existing engines, with the conversion from carburetion to fuel injection being the most significant. The mini-computer that controls the injection timing and duration is based on known technology, and manufacture of the catalyst is similar to that for the dual-catalyst system. Once a satisfactorily durable oxygen sensor is developed, its manufacture should be relatively simple. Production of this system for the 1976 model year is quite feasible, provided the following have been accomplished by mid-1973:

- Freeze design for production
- Commit to pump and nozzle plants
- Build low-volume production tooling and vehicles
- Field test low-volume production vehicles
- Commit to electronic emissions control unit plant and tooling

5.2 Manufacturability and Costs of Automotive Exhaust Catalysts

As discussed previously, most manufacturers plan to use a dual-catalytic system for 1976 model year vehicles. From a manufacturing standpoint, the problems of producing oxidizing and reducing catalysts are the same. The catalyst manufacturers who propose pelletized catalysts already have the sources for a substantial portion of the carrier materials and some capacity for coating with the active material. This type of catalyst is used extensively in the petroleum industry. The manufacturing facilities need only to be increased or additional similar type of equipment provided.

Many companies are active in the development of catalysts and substrates. In addition to the long-established catalyst and substrate manufacturers, General Motors has recently disclosed that they have developed an extrusion method for making monolith catalyst carriers. They have plans for constructing these facilities and have indicated their intention to become major emission-control catalyst manufacturers, including the carrier containers and possibly the active material that is coated on the carrier.

It has become increasingly apparent that 1976 catalysts will require the use of large quantities of noble metals. The two noble metals of greatest promise are platinum and palladium; for oxidation alone, a car of 350-cubic-inch displacement would need up to 0.15 ounces of either metal. This figure would be doubled if the requirement for the NO_x catalyst is similar. Thus, there would be a demand of as much as 3 million ounces for the initial installation of the catalytic converters required, a figure comparable to the world production in 1970. Ruthenium is the most promising NO_x catalyst, although it is in short supply. The recovery of platinum contained in spent catalyst delivered to the door of precious-metal refiners should be above 99 percent. The efficiency of scavengers in collecting spent noble-metal catalysts is difficult to estimate. Since the value of the recovered metal is of the order of $15-20 per car, efficiency of scavenging should be high. For comparison, copper is 50¢ per pound and 61 percent of scrap copper is recycled in the United States. Most base-metal catalysts are promoted with precious metals at less than 0.01 ounce per car. In this case, there is less incentive for scavengers to collect resources.

It appears that the required amounts of noble metal can be made available to meet production schedules if decisions are made early enough; postponement would cause increasing difficulties with delivery. Some companies have delayed decisions because of the very large commitments for opening mines and having new plants built.

5.3 Summary of Costs of Various Proposed Systems

The relevant cost concept is the total cost to the American people of meeting the emission standards, which must be weighed against the cost of air pollution by present automobiles with their attendant human discomforts and illnesses. This includes not only increases in automobile purchase prices, but also increased costs of fuel, maintenance, repair, and driveability that result from pollution-control devices. Of these considerations, it is especially difficult to relate poorer driveability to a cost in dollars, but the customer pays in other ways, e.g., through frustrations and delays. Dollar estimates of the other costs can be made, although these are necessarily imprecise because of uncertainties at this stage.

A summary of the estimated increments in annual costs due to emissions-control systems for several possible 1976 car and engine combinations is given in Table 5-4. The engines are those that have been discussed, and price increments have been calculated for those car-engine combinations that appear feasible. The stratified-charge 3-valve engine may eventually be developed for larger cars, but so far its potential for low emissions has been demonstrated only in small cars. The cost increments are measured from equivalent 1970 model cars as a baseline, and these annual costs are amortized over a five-year period. These figures include not only the direct cost of emissions hardware, but also associated costs of redesign of the rest of the car to accommodate the new systems. These associated costs include weight penalties, which can be quite significant in either direction; e.g., diesel-powered cars will be relatively heavy, whereas an automobile designed around the compact Wankel engine can be appreciably lighter than present cars.

Estimates of increased costs of fuel consumption and maintenance due to emission controls are also included in the figures in Table 5-4. Of the five engines listed, the emission-controlled diesel

Table 5-4

Total Annual Cost to Customer of Emission Controls[a]
For Various Body and Engine Combinations

	Subcompact	Compact	Intermediate A[b]	Intermediate B[c]	Standard	Standard Luxury	Luxury
Dual-Catalyst System	127	138	215	243	263	285	361
Diesel with EGR	18	-45[d]	30	-18[d]	36	41	14
Wankel	86	117	120	105	133	198	148
Stratified-Charge 3-valve	65	77	67	-	-	-	-
Feedback-controlled with Electronic Fuel Injection	51	50	85	52	87	97	114

[a]Compared to cost of 1970 base-line car and amortized over five years. Includes increments in fuel and maintenance costs. Fuel-cost estimates were based on 40 cents per gallon for all fuels and all years.

[b]Intermediate A bodies are those intermediates that currently use 6-cylinder engines.

[c]Intermediate B bodies are those intermediates that currently use 8-cylinder engines.

[d]The diesel 4-cylinder is used in Compact cars and the 6-cylinder is used in Intermediate B cars.

and the stratified-charge engines show promise for fuel economy competitive with 1970 gasoline engines. The feedback-controlled spark-ignition engine with electronic fuel injection promises reasonable fuel mileage, because of its operation near stoichiometry, but will still suffer a 10-15 percent fuel penalty over 1970 engines. The dual-catalyst system proposed by most manufacturers will use about 25 percent more fuel than its 1970 counterpart; and the Wankel configuration, which seems most likely to meet the 1976 standards, will probably pay a fuel penalty of approximately 30 percent, due to its rich mixture ratio.

5.4 Exercise to Illustrate the Impact of Possible Use of a Mix of Engines and Control Systems

As mentioned earlier, the American automobile producers are by and large seeking to meet the 1976 requirements with a dual-catalyst modified carbureted piston engine across their car lines. However, it is quite unlikely that any single engine type or control system will prove suitable for all sizes and types of 1976 automobiles. Furthermore, several new low-emission engine configurations may well phase in to replace some of the carbureted piston engines. Clearly, phasing in of these various new engines and control systems and phasing out of the engines they replace will have an effect on sticker price due to the capital costs incurred. A computer simulation of the dynamics of such a process was carried out to determine the magnitude of this effect. Although any set of assumptions could have applied in this simulation, a set was chosen which leads to a relatively high impact on the industry, i.e., it phases out the present type engines very quickly. (It should be emphasized that the Committee does not consider such a drastic change to be probable.) The following are the assumptions used:

1. The modified carbureted piston engine equipped with an oxidation catalyst will be produced only in model year 1975 and no modified carbureted piston engine using catalytic control of emissions will be produced in model year 1976.

2. The Wankel engine will be introduced initially in the small cars (subcompact and compact) and subsequently will be developed in higher-horsepower versions for larger vehicles.

3. Diesel engines (4 and 6 cylinders) will be introduced for fleet-car usage by 1975. A V-8 Diesel will be introduced subsequently.

4. A limited number of stratified-charge engines (3-valve) will be introduced in 4- and 6-cylinder versions for small cars.

5. Gasoline engines with electronic fuel injection will be introduced by 1976 in 4-, 6-, and 8-cylinder versions in very large quantities.

Applying these hypothetical assumptions to the simulation model, the capital-investment impact on manufacturing facilities was then developed, as a sticker price increase. In the model, the aggregate American production was considered without identifying the specific producer. The car configurations were detailed down to the major components and subassemblies. These units were then scheduled in production in the proper sequence and at the proper time to yield the desired schedule using standard industry lead times. These numbers were developed giving due consideration to expected product life and normal industry amortization practices. The expected sticker-price increases to return the capital investment in new production lines, old production-line tear-up, assembly-line change, and new facilities were found to range (even with such a drastic change in engines and control systems in such a short time) from $8 to $150 per car.

6. ALTERNATIVE SYSTEMS FOR LOW-EMISSION AUTOMOBILES

The Committee also considered power systems other than Otto-cycle gasoline engines. It became apparent quite early in this study that no alternative power system could be produced in sufficient numbers by 1975 or 1976 to displace an appreciable part of present engine-production quantities. Several power systems (e.g., Rankine, Stirling, batteries, fuel cells) show promise for eventually meeting 1976 standards, but development time and cost reduction are necessary before these can become competitive. Two engines (diesel and gas turbine) show promise of meeting 1975 emission standards. However, even though such engines have already been adapted to passenger cars, little develment is being done on them for 1975 and 1976 because they are costly and have other detractive characteristics. The present diesel is heavy, tends to smoke, and its exhaust is odorous. The gas turbine has poor fuel economy at part load, and the NO_x emissions are not presently controllable to low enough levels.

Although it is unlikely that any alternative engine will be in appreciable mass production by 1975 or 1976, some of them will be phased in within the next decade. Thus, summaries of the findings concerning the various systems are given below.

6.1 Diesel Engines

Recent data show that several current four-stroke, and one two-stroke, diesel engines can meet 1975 standards for carbon monoxide and unburned hydrocarbons. A typical NO_x value for a current Mercedes Benz 220D under the CVS-CH test is 1.65 g/mile. There have been no results obtained on diesel engines showing ability to meet the 1976 NO_x standard of 0.4 g/mile. Daimler-Benz estimates that the lowest NO_x levels achievable for diesels at the present state of the art would be about 0.8 g/mile.

New developments in diesel engines, such as a two-stroke engine with a new, low-emission combustion method, and the use of positive-displacement rotary prime movers, such as the Wankel-engine configuration, offer the future possibility of meeting, or nearly meeting, 1976 standards with an engine that is smaller and cheaper than the present (1970) gasoline engine. Much work must still be done to prepare even suitable prototypes of these concepts.

There is a good possibility that a diesel engine of sufficient power density, light enough weight, and emissions nearly satisfactory for 1976 automobile can be built. But much engineering work must still be done before there can be a proven concept. Potential problems of smoke, white smoke, odor, and noise still remain. It appears that good single prototypes of the advanced engine will not be available before 1975. Limited production might be possible by 1980.

A passenger-car diesel engine designed according to existing technology may have a possible disadvantage in slightly greater weight and larger size over a spark-ignition engine of comparable output. It may cost more basically, but the difference shrinks when the emission controls for gasoline engines are added in, since the add-ons for diesels to meet 1975 standards are minimal. It will give better fuel economy and require less maintenance, which should quickly make up any first-cost difference. The efficient diesel will tolerate a wide range of fuels and becomes of greater interest as our concerns with energy conservation increase. Because fuel of lower volatility is used, diesel engines have an additional safety factor, and also there would be less fuel-vapor emissions at the filling station.

6.2 Gas Turbines

Gas turbines are a feasible method of propulsion for standard-size U. S. passenger cars. In prototype form, they have demonstrated acceptable or superior weight, size, fuel consumption, driveability, maintainability, resistance to abuse and neglect, and safety. Carbon monoxide and hydrocarbon emissions are below the 1976 standards; NO_x emissions are presently above the 1976 limits, but several approaches have shown that it is technically feasible to lower NO_x to 1976 requirements especially for low-pressure-ratio engines. The concepts can probably be incorporated in a prototype by 1976. The added controls or costs of reaching 1976 NO_x standards are not yet known.

Gas turbines to date have all shown poor fuel consumption at low design power and while operating at low fractions of the design power. Highly regenerated units tend to limit the effect, but the possibility of economic gas turbines having design power below 150 horsepower and operating under lightly loaded conditions is still a controversial matter.

The retail costs of future gas turbines installed in automobiles are highly uncertain. Estimates made by various highly qualified individuals or organizations run from a price below that of the cleaned-up spark-ignition engine to one three or four times higher. These estimates are based on the use of materials similar to those in today's engines.

Future possibilities for gas turbines improve as the use of ceramics for many parts is proven. If ceramics become widely available for the hot parts of gas turbines, it is generally agreed that the engines would eventually cost less than the spark-ignition alternative. In addition, the employment of critical resources would be greatly reduced.

A realistic schedule for advanced gas turbines to be produced in quantity would be for advanced limited-production engines by 1982, followed by mass production by 1984.

6.3 Stirling Engines

At the present state of development, Stirling engines are very efficient engines that could allow high-performance full-size automobiles to meet the 1976 emission standards. Any form of heat energy or fuel source can be used to operate it. The engineering problems that remain to be solved before it would be possible to adopt them as practical engines for limited application relate to the reliability of sealing the working fluid inside the engine, to the cost and reliability of the heater assembly, and to the development of a simple, versatile power-output control system. Considerably more engineering is necessary to allow the engine to be considered as an entirely suitable automobile power plant. Additional developments necessary to make this possible relate to cost, operation in the hands of the customer, and integration into the automobile. The two sets of problems are best attacked simultaneously and may involve changes in the present form of the engine.

The potential of the engine goes well beyond its present state. Size, weight, producibility, safety, response to abuse and neglect, starting ease, driveability and versatility, control ease, fuel economy, noise, emissions, and cost potential all show indications of being competitive with or better than diesels in the present generation of development, and equal to or better than gasoline engines in the next generation of development. Thus, the engine could fit into the auto industry, truck industry, and other segments of the transportation industry, independent of the eventual outcome of the energy crisis or the fuel controversy. Approximately 4 to 10 years of additional development will be required to solve the outstanding engineering problems and produce a prototype advanced Stirling engine suitable for present-type automobiles.

6.4 Electrically Driven Vehicles

Electrically driven vehicles in principle provide freedom from pollution and are characterized by high energy efficiency, flexibility of performance, good durability, and low maintenance requirements. At present, the limiting factor relating to the technical and economic feasibility of electric vehicles is the vehicular power source. Electric drive systems (motor and controls) having excellent characteristics have been demonstrated; development of optimal drive systems is not considered to be limiting in the ultimate realization of electric automobiles.

Fuel-cell-powered electric vehicles in which the free energy of fossil fuels is directly converted into electrical energy for motive power do not emit CO or NO_x; unused hydrocarbons can be easily removed from the exhaust. Fuel cells are not heat engines and are not subject to the Carnot limitation. For this reason they may operate at very high energy-conversion efficiency, resulting in superior fuel economy.

Although some fuel-cell systems have been successfully deployed in space missions, these are not adaptable for applications where low cost is important. Current advanced developments directed toward stationary applications in commercial and consumer markets are in the field-test stage. These represent important cost reduction and performance improvements relative to the aerospace units. With further significant cost and performance improvements, vehicular applications in small quantities may become feasible within 10 to 15 years.

Vehicles that employ rechargeable batteries as a power source do not have emissions resulting from the combustion of fuels; the site of emissions is transferred to central power stations where such emissions are understood to be more effectively controlled, and at a lower cost. Because of the high efficiency of batteries and of electric drives, the net fuel economy of such vehicles promises to be better than that of present automobiles. Furthermore, if we move toward an electric economy, batteries may assume a unique role in the transportation system.

In contrast to fuel cells, extensive experience exists with respect to the performance characteristics of at least one battery system-lead/acid. This battery is rugged, efficient, reliable, and can respond instantaneously to large changes in load. Presently available special-purpose vehicles can provide ranges of up to 50 miles and modest acceleration marginally acceptable under urban driving conditions, at a high cost. Other currently available rechargeable batteries, such as zinc/silver-oxide and cadmium/nickel-oxide, while superior in some respects to the lead/acid system, are inherently unsuitable for vehicular applications because of cost and/or limited availability of materials. Still other battery systems concurrently in various stages of development offer significant performance improvements, and may meet the cost and materials requirements for vehicular applications.

The zinc/nickel-oxide battery is expected to allow a vehicle design with acceptable acceleration and a range of about 80 miles between recharges.

The most promising of the advanced battery systems are sodium/sulfur and lithium/sulfur batteries, which operate at temperatures in the range 300-400°C, and are maintained at operating temperature by their reject heat and appropriate thermal insultation. These batteries are expected to have specific energies of 100 watt-hours/pound and specific powers of 100-200 watts/pound, permitting the design and construction of electric vehicles with excellent acceleration capabilities and a range of about 200 miles between recharges. About 7 or 8 years of optimum effort will probably be required for the development of pilot quantities of these batteries for vehicle test purposes. Still other promising nonaqueous systems are in early stages of exploration.

Hybrid electric/heat-engine powerplants are claimed to enable reduction of the emission of air pollutants. The expected improvement in driveability by using the electric motor for power surges should allow the heat engine to operate cleanly and economically at one setting or with a slowly varying setting over a range. There are significant penalties in the areas of cost and complexity that must be overcome before the hybrid can be considered a viable contender. Even if the technical and economic criteria can be met, it is doubtful whether introduction of this new and complex power-plant scheme will represent any more than an interim solution with respect to pollution abatement and effective use of natural resources.

6.5 Rankine Engines

Tests made on Rankine-engine components have shown that the 1976 standards could probably be met with Rankine-engine-powered, standard-size automobiles. Various approaches to the design indicate that Rankine engines can be made to fit into full-size automobiles. These findings are to be demonstrated with working units in real automobiles by 1975.

Engine noise promises to be low except for the condenser fans, which could be troublesome due to large air-flow requirements. Starting should be easy, although time-consuming (one minute being a practical estimate). The driveability of Rankine-powered automobiles should be satisfactory if a sufficiently high power-to-weight ratio can be achieved.

One full-size automobile has been fitted with a 150-horsepower steam engine. Emissions did not meet 1976 standards and there were other detracting features, which can be traced partly to the underdeveloped nature of the engine. Lower-power steam engines have been fitted into compact-size automobiles and demonstrated. Low power density is a general characteristic of these engines, traceable to poor efficiency.

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Newer forms of Rankine engines that use organic fluids flowing through either reciprocating or turbine machinery offer the possibility of trouble-free operation (no freezing, easy starting) at the expense of poorer fuel economy as compared with steam. These units will be larger and more difficult to integrate than will steam engines.

The Rankine cycle in any version will tend to have relatively uniform specific fuel consumption over the operating range. This leads to reasonable fuel economy (but less than that of gasoline-powered automobiles of similar size) over typical driving schedules when steam, or the best organic-fluid, engines are considered.

To achieve an engine with reasonable fuel economy, the controls have to be complex and the engine has to be as large as possible within the allowable envelope. Thus, any Rankine engine will be pushed to the allowable limits on size, weight, and cost for a given application, and the automobile will be considerably underpowered and overpriced as compared with a gasoline engine in the same application. Despite its potentially good emissions, driveability, and low noise, most of the other realistic evaluation features for automobile engines (such as size, weight, cost, fuel economy, and starting time) are missed by the Rankine engine, independent of type.

It is problematic whether even limited production of full-power engines could be feasible before 1980. Limited production of existing designs for low-power applications could begin by 1976-77.

Major questions remain to be answered affirmatively with respect to safety, operability, reliability, and overall driving versatility in the hands of the public. Unit cost and the ability to be phased into production present even larger questions for which affirmative answers are lacking.

A suitable full-size, prototype Rankine engine will not be available until 1975 (EPA schedule). Development of a manufacturable prototype must follow this by several years, which must in turn be followed by normal development.

6.6 Other Engines

A wide variety of other engines with some potential advantage over the gasoline engine or diesel engine have been considered over the years. Most of these have not been developed even as far as the automobile gas turbine, Rankine engine, or Stirling engine. None of them seem to offer a clear-cut advantage in emissions over the other types, and they all offer some increase in complexity, weight, volume, and probably cost.

Systems using positive displacement machinery but with combustion taking place outside the cylinder (out-of-cylinder combustion systems) have been studied for engines operating on the diesel cycle, the Otto cycle, the Brayton cycle, and many variations. They all suffer from lowered efficiency, larger size, and probable high NO_x values. None of these systems appear to offer any basic advantage that cannot be achieved ultimately by diesels, gas turbines, and Stirling engines, all of which show promise of lower cost.

7. DISCUSSION

7.1 Introduction

As a result of the Clean Air Amendments of 1970, automotive and related manufacturers - both within and outside the United States - have embarked upon research, development, and manufacturing programs designed to meet the newly established emission standards for light-duty motor vehicles. As observed in the January 1972 report of this Committee, it is unfortunate that the automobile industry did not seriously undertake such a program on its own volition until it was subjected to governmental pressure. A relatively modest investment, over the past decade, in developmental programs related to emission control could have precluded the crisis that now prevails in the industry and the nation. The current crash programs of the major manufacturers have turned out to be expensive and, in retrospect, not well planned.

Nevertheless, the almost world-wide effort to achieve the federal emission standards set for the light-duty motor vehicles in the United States has produced a significant rate of progress toward meeting the requirements of the Clean Air Amendments of 1970. It is the very pace of that progress that complicates judgment today concerning the most appropriate course of action with respect to attainment of the standards required by that law.

As discussed in earlier parts of this report, several systems have been shown capable of attaining emission certification in 1975 model year cars. Among these are the diesel (discussed in Section 6.1) and the three systems discussed in Section 3.2 (the conventional engine with modification and oxidation catalyst, the Wankel with a thermal reactor, and the carbureted three-valve stratified-charge engine). While continued progress can be expected in development of all these systems, they do not possess equally desirable characteristics.

Several control systems in early states of development have met the 1976 standards at low mileage. Some of these represent further development of systems designed for certification and manufacture in model year 1975. Others are relatively new and their ultimate manufacture will require energetic commitment by the industry to further develop approaches that have been pursued only in smaller companies and at relatively low levels of effort. One system promises to be acceptable in use for the full 50,000 miles. Durability and other performance data are already available for that system. The future performance and acceptability of other systems - especially those currently being developed by the principal manufacturers - remain in doubt. In the following discussion, we shall briefly compare those systems that warrant consideration for certification and production in model year 1976.

7.2 Dual-Catalyst System

To date, the belated research and development programs of the major automobile manufacturers have been devoted almost entirely to the development and incorporation of such minimal modifications to the basic spark-ignition, internal-combustion engine as may be required to achieve certification in 1975 and 1976. This situation is a result of the short time between passage of the Act and the scheduled date of its enforcement, and the desire of the manufacturers both to protect their investments in the internal-combustion engine and to utilize their vast experience with this engine. The modifications made to achieve emission levels required by the 1973 federal standards represent just such continued development of the conventional engines of previous years.

To achieve the further reductions called for by the 1975 and 1976 standards, most major manufacturers currently plan to use catalysts in the exhaust stream to promote both oxidation of carbon monoxide and hydrocarbons and chemical reduction of NO_x. The CMVE believes that engines equipped with oxidation catalysts will be able to meet the certification requirements for model year 1975. At this time, no experimental engine modified to include the dual-catalyst system has exhibited the durability required to achieve compliance with the 1976 standards. Nevertheless, assuming a continuation of the intensity of the current effort, extrapolation of the rate of recent progress suggests that catalysts with the durability required by the 1976 standards will be developed. But it cannot be stated with certainty that such developments will occur in time for 1976 production of automobiles.

Although American manufacturers and others evidently will be able to produce catalyst-equipped vehicles capable of certification for the 1975 model year, and even possibly capable of 1976 certification, compliance with the certification procedure, of itself, may not constitute indication of satisfactory performance of catalyst-equipped vehicles in actual customer use. As discussed in Section 4.2, the diverse conditions to be undergone by the engine and control systems during 50,000 miles of customer use are far more strenuous than those undergone during certification. These more strenuous conditions may result in significant damage to a catalyst. In view of the performance history of catalytic systems observed to date on experimental vehicles, under laboratory conditions, there is concern that there may be frequent catalyst failure under conditions of actual use well before a scheduled 25,000-mile replacement.

Admittedly, there has not been actual customer-like experience with catalytic systems that have met the 1975 or 1976 certification requirements, and these concerns may be overdrawn. Furthermore, failure in service of cars properly maintained and used will call into operation Section 207(c) of the Act, by which the manufacturer can be forced by EPA to remedy the deficiency at his own expense. Obviously, this concern would be relieved by either the expected early development of catalysts demonstrably more rugged and durable than those tested to date, or by demonstrated satisfactory performance, in conditions similar to customer use, of those catalysts now under investigation.

Only one manufacturer has commenced such tests with a few cars equipped with a single-catalyst system that have met the 1975 standards. Final judgment of the actual performance of such systems must await experience.

7.3 Alternatives to the Dual-Catalyst Approach

In view of the fact that the dual-catalyst approach to a non-polluting automobile power plant may not lead to a truly satisfactory long-term solution to the environmental problem, it is encouraging to note that promising alternative systems are under intensive investigation. Although some are only in the earliest stages of development, others are more advanced and promise to achieve 1975 emissions certification when utilized on smaller engines. These include the carbureted three-valve stratified-charge engine, the modified diesel, and the Wankel with thermal reactor. Each of these alternative systems is described below.

7.3.1 Carbureted Three-Valve Stratified-Charge Engine

Prototype compact cars equipped with the carbureted three-valve stratified-charge engine have met the 1975 standards for 50,000 miles. Three tests on vehicles equipped with an advanced version of this system show average low-mileage emissions of 0.25 grams per mile HC, 2.50 grams per mile CO, and 0.43 grams per mile NO_x (see Table 3-11). This system should be capable of certification on small cars in time for model year 1976 production, and with an adequate margin of safety for each of the three contaminants. This approach should also be applicable to larger engines, but sufficient experience is not yet available for evaluation.

A substantial degree of confidence can be placed in the estimation that the emissions performance of this engine in use will be quite close to its performance during certification. The maintenance required on the carbureted stratified-charge engine should be no greater than that required on a conventional 1973 engine. In fuel economy, this engine is comparable with a 1972 engine and much superior to a dual-catalyst-equipped 1976 engine.

7.3.2 Diesel Engines

Emissions achieved by a current diesel-powered vehicle are 0.15, 2.5, and 1.65 g/mile for HC, CO, and NO_x, respectively, and this engine is certifiable for 1975 production. Further improvements are possible, but much innovative engineering work must still be done before the diesel can meet the 1976 standards. Limited production of adequately improved vehicles might be possible by 1980. Since the diesel would provide a significant fuel economy, even compared with 1972 engines, further development of the diesel warrants encouragement.

7.3.3 Wankel Engines

As shown in Table 3-7, the Wankel engine with thermal reactor on a compact car has met the 1975 standards with NO_x levels of about 1 g/mile for 50,000 miles, but with a fuel penalty of about 30 percent compared with a 1973 equivalent piston engine. The use of EGR and richer carburetion can probably further reduce NO_x levels, but at the cost of even greater fuel consumption, and even so it is not yet certain that the 1976 standard for NO_x can be achieved.

Durability performance of the Wankel engine with thermal reactor on a compact car has been shown to be superior to that of the dual-catalyst system. However, temperatures experienced by the reactor during operation in the hands of the public should be somewhat higher during certain driving modes, and durability under such conditions has not been established.

7.3.4 Catalytic Systems with Feedback Control

A system with three-way catalyst and feedback control (see Section 3.6) promises improvement over the dual-catalyst system. However, adequate durability data with respect to both the catalyst and the oxygen sensor are not available to make meaningful estimates of the performance of such systems either during certification or in use.

Feedback control of a dual-catalyst system would be expected to increase the life of the catalyst, reduce emissions, and significantly improve fuel economy. At this writing, such a system is not available but may be capable of development, though perhaps not in time for production in quantity in 1976.

7.4 Interim Standards

According to the work statement agreed to by the EPA and the National Academy of Sciences, "Should the Contractor conclude that the attainment of emission standards on the schedule provided by Section 202(b)(1) of the Clean Air Act is not technologically feasible, the Contractor shall specifically determine technologically feasible interim emission levels to assist the Administrator in exercising his responsibilities under Section 202(b)(5) of the Act." However, the considerations that must enter into the determination of optimal technologically feasible interim standards are so complex and carry so many implications that, as explained below, it is inadvisable and inappropriate for this Committee to recommend a specific set of interim levels at this time.

It is not yet possible to make a definitive prediction with respect to which engine systems will achieve certification for 1976. The most likely candidate is the carbureted stratified-charge system on smaller engines. It is probable that others, particularly the dual-catalyst system, will also qualify at that time. It is conceivable that the projected automobile production for 1976 can be achieved only by a mix of engines, some certifiable and some (probably larger engines) not quite certifiable. However, while it is premature to judge the issue at this time, a rationale may later be required for upward adjustment of one or more of the standards to permit production of a sufficient number of vehicles of various sizes in 1976.

Examination of possible interim standards for the three pollutants is complicated by the fact that the technologically feasible levels of the three pollutants are interdependent. For several of the systems discussed, further decreases in NO_x can be achieved, for example by greater reliance upon EGR, but only by accepting higher levels of CO and HC. Thus, before selection of a particular set of interim levels as achievable, answers will be required to such questions as: Is it more important to reduce NO_x emissions than CO or HC? Or vice versa? Further, compact cars are capable of lower emissions than are standard or large cars with similar control systems, while consuming less fuel. What emphasis should be placed on significantly different levels of fuel consumption that are associated with the various control systems and vehicle sizes and the substantial possible impact on total petroleum requirements?

The Committee made no attempt to resolve these and related questions, as judgments regarding these matters were deemed to be beyond the scope of the study commissioned to the Academy and delineated by the EPA-Academy contract. Thus, at this time, the Committee finds it inadvisable to recommend a specific set of interim standards.

7.5 Effects of a Delay in Enforcement on Total Automobile Emissions

To illustrate the effects of various delays in implementing the emissions standards, should this be found necessary, a computer model was used to calculate total automotive emissions in a typical metropolitan area for the years from 1960 to 2000. This model accounted for factors such as vehicle age distribution among all automobiles, the decrease in vehicle miles driven per year per car as vehicle age increases, the predicted nationwide growth in vehicle population each year, the emission reduction achieved through crankcase blowby and evaporative-loss control, the effect of federal exhaust-emission standards, and deterioration of emission controls with mileage. Vehicle age distribution was taken from a national average automobile population, which is a reasonable distribution for many large urban areas. Urban driving was assumed in the model, and average emissions for urban driving were used. These emissions values were obtained from records for 1972 and older model-year cars. For cars built or to be built after the 1972 model year, the emissions values were based on various implementation plans.

Figures 7.1, 7.2, and 7.3 show the variations in emissions of HC, CO, and NO_x, respectively; these curves are normalized against the maximum for each contaminant. Four cases are represented in each set of curves:

1. Standards maintained at the 1973 levels indefinitely.

2. 1975 and 1976 standards implemented and met on schedule.

3. 1975 and 1976 standards each delayed one year -- the maximum allowable under the law.

4. 1973 standards maintained through 1976 model year and 1976 standards implemented in 1977 model year.

The implementation of emissions controls since 1968 has already caused an appreciable reduction in annual emissions of HC and CO, but little reduction in NO_x. Federal standards for model year 1973 cars call for decreases of approximately 80 percent for hydrocarbons,

FIGURE 7.1 EMISSIONS OF HYDROCARBONS
BY AUTOMOBILES IN URBAN AREAS

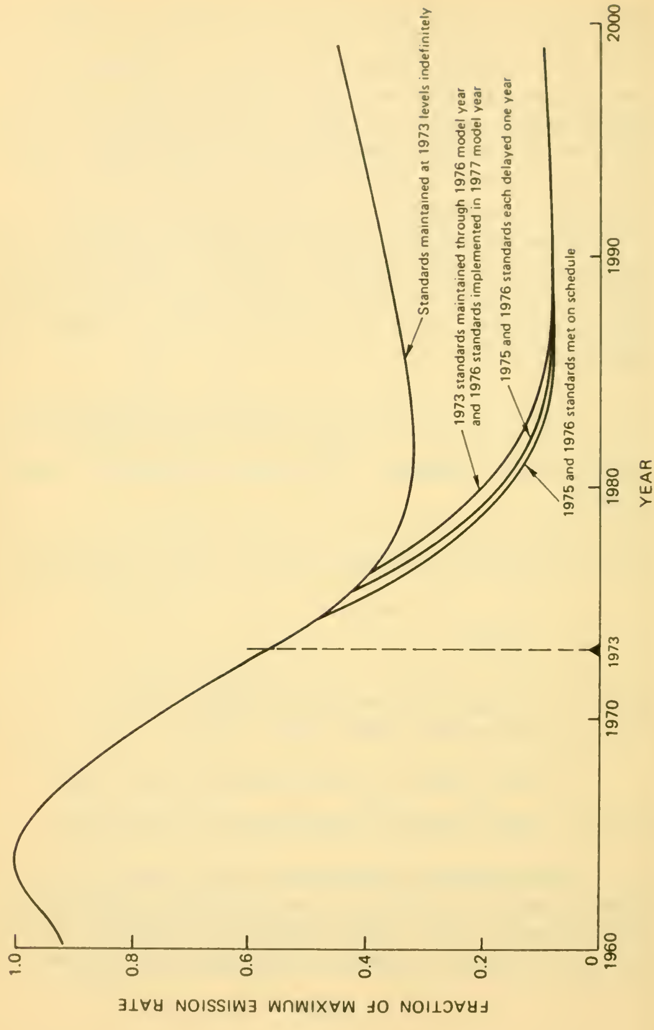


FIGURE 7.2 EMISSIONS OF CARBON MONOXIDE BY AUTOMOBILES IN URBAN AREAS

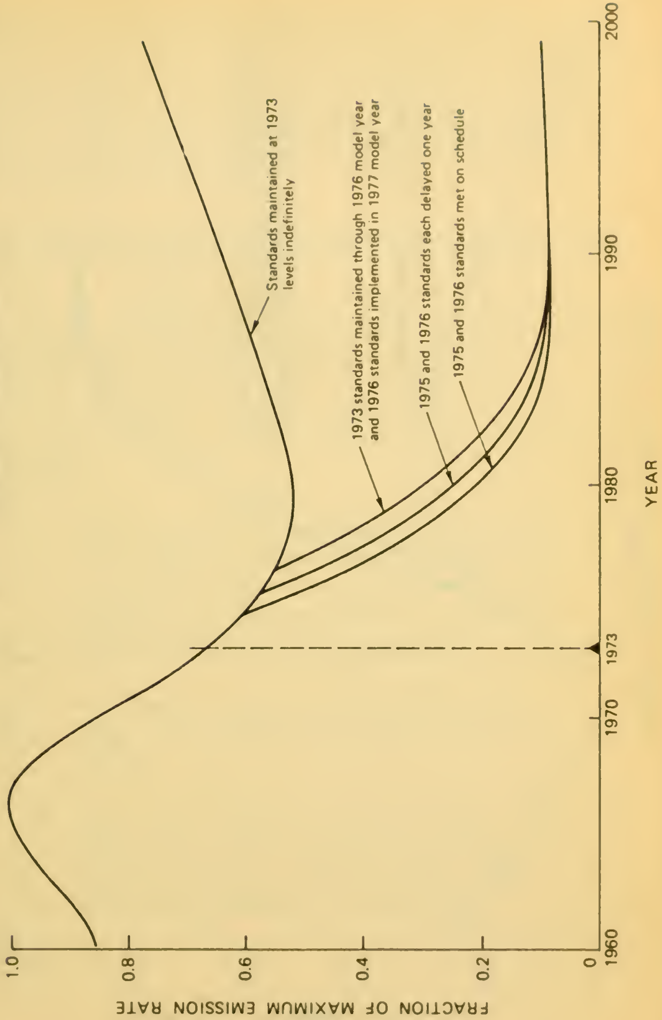
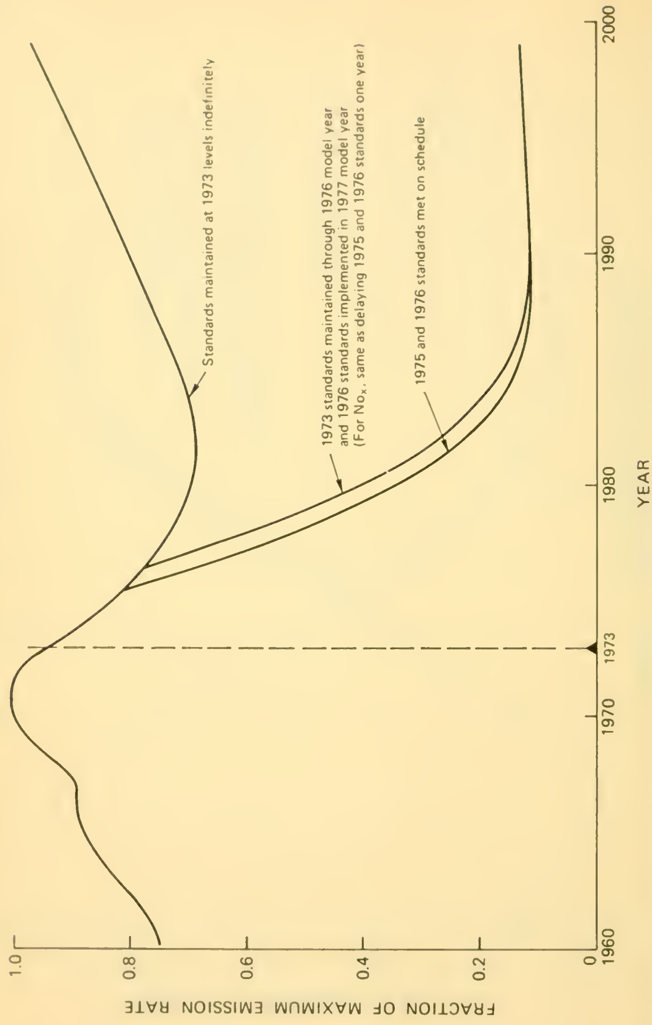


FIGURE 7.3 EMISSIONS OF OXIDES OF NITROGEN BY AUTOMOBILES IN URBAN AREAS



70 percent for carbon monoxide, and 50 percent for oxides of nitrogen, all measured in relation to the uncontrolled emissions of pre-1968 vehicles. As seen in the curves, were 1973 standards to remain in force, total emissions of hydrocarbons and carbon monoxide would continue to decline for some years, as would that of NO_x. Preponderantly, these effects reflect the removal from service of older, uncontrolled, or less-well-controlled automobiles.

7.6 Implementation of 1975 and 1976 Standards and Related Matters

Of two promising candidates for certification and production in 1975 and 1976 - the dual-catalyst system and the carbureted stratified-charge engine - only the former is planned for manufacture on a scale commensurate with expected requirements in those years. Even if durable catalysts became available, the dual-catalyst system would still have several undesirable characteristics, the more important of which are listed below.

1. The dual-catalyst system is expected to have poor fuel economy. Improvements in fuel economy could be obtained by the use of proper feedback control mechanisms, but these are unlikely to become available for production in 1975 or even 1976.

2. Dual-catalyst systems will have a higher initial cost, be more difficult to maintain, and be less durable.

3. Manufacture of vehicles equipped with single- or dual-catalyst systems in large numbers before sufficient experience with these devices under actual diverse consumer use is precarious.

Independent of whether each car must periodically pass inspection or whether the manufacturer is repeatedly compelled to exercise the recall provisions of the Act; if a large fraction of all cars markedly exceeds the emissions standards, the entire rationale of this procedure becomes suspect.

4. The 1973 class vehicles when converted to 1975-76 systems can be expected to be more difficult to start, thus wasting some fuel and increasing emission of pollutants (although it should be possible to mitigate this situation by future technical improvements).

The circumstances recounted above - the probable certifiability of the carbureted stratified-charge engine under both 1975 and 1976 standards but its relatively limited planned production, particularly in 1975, and the considerable promise of other, as yet incompletely developed systems - make judgment concerning an optimal national approach to decision concerning the scheduled implementation of the 1975/1976 standards extraordinarily complex - precisely because the entire research and development aspect of this situation is very much in flux and changing rapidly.

Some members of CMVE are concerned that strict enforcement of the provisions of the Act might, by forcing adoption of the control system first to be developed and certified, defeat the goal of the earliest possible attainment of compliance by the most generally desirable means. These members of CMVE believe that, once having embarked upon large-scale production of the catalyst-dependent control systems, several years would elapse before major manufacturers would alter course in favor of producing more generally satisfactory vehicles. This would happen, it is thought, because it would be consistent with the tradition of the industry of slowly improving technology already in use rather than switch to a significantly new and different technology not yet tried on a mass scale. Further, there is concern that existing market mechanisms would not suffice to accelerate conversion to a substantially different technology at a pace consistent with the overall national interest.

A minority view within the CMVE states that: (a) only rigorous enforcement of the Act will assure the pace of continued progress toward the goals of the Act; (b) by the time 1975 cars are placed in production, the catalysts used in catalyst-dependent systems may prove decidedly more reliable than are those now available; (c) there is no assurance that the additional development time would not simply be employed by the major manufacturers for further development of the present systems; and (d) the presence on the market of even a small number of alternative control systems that are more reliable, cheaper, and accompanied by a lesser fuel penalty, if any, would constitute an effective market device, which, without other intervention, would assure changeover by the major manufacturers at an acceptable pace, particularly if the recall provisions of the Act are enforced as warranted.

The majority view of CMVE suggests that, on balance, it may be prudent for EPA to consider a delay in the imposition of 1975 a·d 1976 standards, but no longer than that provided for in the Act. It is thought that this would provide the manufacturers an opportunity to consider and implement alternative and, quite possibly, more generally satisfactory technologies with which to attain the goals of the Act. In this view, as shown in Section 7.5, such an action would not result in an unacceptable deceleration in reduction of automotive emissions.

In its work, CMVE became aware of a continuing controversy concerning the stringency of existing emission standards. Strongly held differences of interests and views surround all the major factors that affect the selection of automotive emission standards: the

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health effects of individual pollutants, their relation to ambient concentrations, the relationship of total emissions to primary and secondary ambient pollutant levels, the contribution of automobile usage to total emissions, and the possible relative reductions in emissions from stationary and mobile sources. Some of the issues posed by these considerations are resolvable only by further scientific research; all will require the attention of officials concerned with pollution control.

These matters are so complex and important that the Committee strongly urges an early and thorough reexamination by Congress, EPA, and the Academy of all aspects of motor vehicle pollution standards established in the Clean Air Amendments of 1970 -- their premises, underlying assumptions, the goals that were set, and the interplay among the three pollutants dealt with specifically in the Act. In the light of the material developed in its study, CMVE believes that such a reexamination would be extremely valuable in relating motor vehicle emission control to the many issues relevant to a sound national environmental policy.

Appendix A

Committee on Motor Vehicle Emissions

E. L. Ginzton
Chairman
Varian Associates
Chairman

J. A. Hutcheson
Vice President
Westinghouse Electric Corporation (retired)
Vice Chairman

Sidney W. Benson
Chairman
Department of Thermochemistry and Kinetics
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Thomas J. Watson Research Center

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J. Ross Macdonald
Vice President of Corporate Research and Engineering
Texas Instruments Incorporated

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Edwin S. Mills
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Mrs. Emily J. McDonald
Administrative Secretary
Committee on Motor Vehicle Emissions
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Mrs. Ann Farrar
Secretary
Committee on Motor Vehicle Emissions
National Research Council

Miss Betty Holland
Secretary
Committee on Motor Vehicle Emissions
National Research Council

Special Consultant

James E. A. John*
Head
Department of Mechanical Engineering
University of Toledo

*Professor John served as Executive Director of the Committee on Motor Vehicle Emissions from April 1, 1971 through August 31, 1972.

Appendix B

Panels of Consultants

EMISSION STANDARDS (Panel 1)

Arthur C. Stern
Environmental Science and Engineering
School of Public Health
University of North Carolina
Panel Chairman

Leslie A. Chambers
School of Public Health
University of Texas at Houston

James Fitzpatrick
Environmental Analysts, Inc.

John A. Maga
Air Resources Board
State of California

Richard M. Kamens
Special Assistant to Panel 1

TESTING, INSPECTION AND MAINTENANCE OF VEHICLES (Panel 2)

John N. Pattison
Civil Engineering Department
University of Cincinnati
Panel Co-Chairman

R. Robert Brattain
Pebble Beach, California
Panel Co-Chairman

Marian Chew
Chagrin Falls, Ohio

Jack Gockel
President
Clean Air Research Company

G. C. Hass
Air Resources Board
State of California

William Scott
Scott Research Laboratories

EMISSION CONTROL SYSTEMS (Panel 3)
(for spark-ignition internal-combustion engines)

John B. Heywood
Department of Mechanical Engineering
Massachusetts Institute of Technology
Panel Chairman

J. A. Bolt
Department of Mechanical Engineering
University of Michigan

Ernest Jost
Materials and Electronic Controls Group
Texas Instruments, Inc.

Henry K. Newhall
Fuels Division
Chevron Research Company

William A. Sirignano
Guggenheim Laboratories
Department of Aerospace and Mechanical Sciences
Princeton University

Henry Wise
Stanford Research Institute

David Wulfhorst
Cummins Engine Co., Inc.

ALTERNATE POWER SOURCES (Panel 4)

John Bjerklie
Schenectady, New York
Panel Chairman

Elton J. Cairns
Senior Scientist
Chemical Engineering Division
Argonne National Laboratory

Henry J. Korp
Howell Corporation

Charles Tobias
Department of Chemical Engineering
University of California

David G. Wilson
Department of Mechanical Engineering
Massachusetts Institute of Technology

Clarence Zener
University Professor
Carnegie-Mellon University

Kurt H. Weil
Special Consultant to Panel 4

MANUFACTURING AND PRODUCIBILITY (Panel 5)

Maurice Nelles
La Jolla, California
Panel Chairman

Donald Bartlett
A. T. Kearney & Company, Inc.

George D. Clayton
George D. Clayton & Associates

Merrill L. Ebner
College of Engineering
Boston University

LeRoy H. Lindgren
Rath and Strong, Inc.

DRIVEABILITY (Panel 6)

King D. Bird
Vehicle Research Department
Cornell Aeronautical Labs

Leonard Segel
Highway Safety Research Institute
University of Michigan

ATMOSPHERIC CHEMISTRY (Panel 7)

Edward Stephens
Statewide Air Pollution Research Center
University of California

Lowell Wayne
Los Angeles, California

CATALYSTS (Panel 8)

James Wei
Allan P. Colburn Professor
Department of Chemical Engineering
University of Delaware
Panel Chairman

Robert Burwell
Department of Chemistry
Northwestern University

Joe W. Hightower
Department of Chemical Engineering
Rice University

David F. Ollis
Department of Chemical Engineering

Appendix C

Persons, Groups, and Companies from whom the Committee Obtained or Sought Information

In the course of its study, the Committee on Motor Vehicle Emissions obtained and sought out information from a wide range of sources in the United States and abroad. As previously reported (in the Committee's January 1972 Report), an initial invitation was extended to the public to submit information and comments in September 1971 (this invitation was later published by EPA in the Federal Register: 36 F.R. 23092). A follow-up invitation was sent by the Committee on June 28, 1972, to 31 individuals and environmental groups known, on the basis of their participation in EPA hearings, to have a special interest in the subject. A copy of this letter appears below, following a listing of those persons, groups, and companies from whom information was obtained during 1972.

Aerojet Liquid Rocket Company
Air Products and Chemicals, Inc. (Houdry Division)
Air Quality and Automobile Emissions Conference
American Cyanamid Company
American Lava Corporation
American Motors Corporation
American Oil Company
American Petroleum Institute Research Section
Arbeitsgemeinschaft Verstaerkte Kunststoffe
Arizona State Department of Health
Arvin Company
Atlantic-Richfield
Audi NSU Motorenwerke
Austin Tool Company
Automobile Manufacturers Association
Bendix Corporation
BICERI, Ltd.

British Leyland Motors Corporation, Ltd.
British Railway Technical Center
California Air Resources Board
Carter Carburetor Company
Caterpillar Tractor Company
CAV, Joseph Lucas, Ltd.
CGE Marcoussis Laboratory
Champion Spark Plug
Chemische Werke Huels
Chrysler Corporation
Citroen
Clayton Manufacturing Company
Compagnie General Electrique
Comotor
Corning Glass Works
Cummins Engine Company, Inc.
Curtiss-Wright Corporation
Daimler-Benz A.G.
Degussa
Detroit Diesel
Deutsch Automobilgesellschaft
Dresser Industries
E. I. duPont deNemours & Company
Electricity Research Center
Electrochemical Society
Engelhard Chemical and Minerals Corporation
Environmental Protection Agency
Erren, Rudolph A.
Esso Research and Engineering
Ethyl Corporation
Fachverband Kohlechemie und Petrochemie
Fiat, S.p.A.
Ford Motor Company
Garrett AiResearch

General Electric Corporation

General Motors Corporation

Gould, Inc.

Gulf Research and Development Company

Hamming and Dickinson

Holley Carburetor

Honda Motor Company, Ltd.

Humble Oil Company

Imperial Chemical Industries

Institute fur Kunststoff VerArbeitung

International Harvester, Inc.

International Materials Corporation

Isuzu Motors, Ltd.

Japan Catalytic Chemical Company

Jersey-Alsthom

Jersey Enterprises

Johnson-Matthey, Ltd.

Kali-Chemie

Kinergetics, Inc.

Kinetics Corporation

Krauss-Maffei A.G.

Lear Motors

Linde A.G.

M.A.N. (Maschinenfabrik Augsburg-Nuernberg, A.G.)

Matthey-Bishop

Mazda Dealerships

McCulloch Corporation

Mercedes Dealerships

MERDC

Messerschmitt-Boelkow-Blohm G.m.b.H.

Mitsubishi Motors Corporation

Mobil Oil Company

Monsanto Company

National Petroleum Refiners Association

New Jersey Department of Environmental Protection

New York City Department of Air Resources

New York State Department of Motor Vehicles

Nissan Motor Company, Ltd.

NLPG Association

Noel Penny Turbines Ltd.

Northrop Corporation

Oxy-Catalyst, Inc.

Paxve Corporation

Perkins Engine Company

Petro-Electric Motors, Ltd.

Philips Corporation

Pratt & Whitney Aircraft

Questor Automotive Products Company

Ragone, Dr. David (AAPS)

Renault, Inc.

Revom, Inc.

Ricardo & Company Engineers, Ltd.

Robert Bosch, G.m.b.H.

Rolls Royce Motors, Ltd.

Scott Research Laboratories

Technische Hochschule Aachen

Technische Forschungsanstalt & Entwicklungsstelle

Texaco Research Laboratories

Thermo Electron Company

Thermo-Mechanical Systems Company

Toyo Kogyo Company

Toyota Motor Company, Ltd.

TRW Systems Group Corporation

Union Oil of California

U.S. Army Tank-Automotive Command

United Stirling A. B. & Company

Universal Oil Products

Varta

VEBA Chemie

Verein Deutscher Ingenieure

VGW-VERBAND der Deutschen Gas und Wasserwerke

Volkswagen

Volvo, Inc.

Walker, Professor Joe

Wankel Symposium of Society of Manufacturing Engineers

Williams Research

W. R. Grace & Company

Zwick Company

Text of Committee Letter of Invitation, June 28, 1972, Seeking Information from Public and Environmental Groups

As provided for in Section 202(c) of the Clean Air Amendments of 1970 (PL 91-604) the National Academy of Sciences is currently conducting a study and investigation of the technological feasibility of meeting the motor vehicle emissions standards prescribed in Section 202(b) of the law. This study, which is being conducted by our Committee, forms an integral part of the process by which the Environmental Protection Agency (EPA) Administrator rules upon requests for suspension of the applicable effective dates.

Since it commenced its work last year the aim of our Committee has been to secure the widest possible range of information and informed opinion. While we have sought out many sources of such information, we have also encouraged individuals and organizations to submit whatever material or comment they believe is relevant to our inquiry. On September 21, 1971, we circulated to several hundred groups, publications, and individuals an invitation to submit their views to the Committee. This invitation also appeared in the Federal Register.

As the Committee's study moves ahead we want to renew our invitation and extend to you and your organization another opportunity to provide us in writing with such information and comment as you may care to make with respect to the subject of our study, namely, the technological feasibility of meeting the statutory emissions standards on the schedule contemplated by the Clean Air Amendments. To be somewhat more specific, the Committee is now giving the bulk of its attention to the standards for oxides of nitrogen, for 1976 model-year vehicles. Of particular concern to the Committee are topics such as these:

*What modifications can be made to the conventional internal combustion engine that would insure compliance with the 1976 standards? Can the requisite equipment be produced in sufficient quantity and on a reliable basis to satisfy assumed demand by 1976, taking into account design and engineering lead-time? How much confidence can be placed in the ability of such devices to meet the standard, not only at the time of production, but for the full required period of five years or 50,000 miles?

*With one principal approach to meeting the 1976 standard calling for use of reduction catalysts, it is important to evaluate the confidence that can be placed in their durability and continued effectiveness in actual use. Can you supply any data or information relative to catalyst durability while in use on an automobile, other than that which was publicly submitted to EPA in the May 1972 hearings? If catalysts are unlikely to remain effective for the five year - 50,000 mile period, how often will they have to be replaced and at what costs, how will the vehicle owner (or operator) know that his catalyst has lost its effectiveness, and how can the public be assured that ineffective catalysts are promptly replaced or recharged?

*The objective of the Clean Air Amendments is to permit the production of vehicles in 1975 and 1976 that will meet the emissions standards for 50,000 miles or five years. Given what is known from durability data and other information, is it feasible to meet this goal without requiring some program of periodic inspection and maintenance? What methods exist to determine whether a vehicle in use meets the applicable emissions standards? If a vehicle is found to be emitting in excess of the allowable limits, is it practical to identify with sufficient precision the cause so as to avoid needless and perhaps costly maintenance?

*Aside from the conventional spark-ignition internal combustion engine, what other power plants could be produced in sufficient quantity by 1976 (or 1977) that would satisfy the 1976 standards? What is known of their costs, operating efficiency, and other characteristics?

This listing of topics which are of concern to the Committee is by no means exhaustive. There are many other issues of importance and the Committee is guided solely by a desire to mobilize as much information and opinion as it can as it relates to the matter of technological feasibility of satisfying the motor vehicle standards as prescribed in the 1970 amendments. Consistent with this objective we invite you to submit such information or to offer such comments as you consider pertinent to the subject of our inquiry. To be of use to the Committee your submission should be in writing and be received not later than August 4, 1972. All such materials should be sent to:

Committee on Motor Vehicle Emissions
National Academy of Sciences
2101 Constitution Avenue, N.W.
Washington, D.C. 20418
Attention: Public Submissions

Although we are sending copies of this letter to a substantial mailing list, we would urge you make this letter of invitation known to any person or group that you believe would be particularly interested in it. We would also suggest you might reprint this letter or portions of it in any newsletter or other publication of your organization.

Signed by James E. A. John

Appendix D

Announcements placed in Federal Register requesting information with respect to technological feasibility.

September 9, 1971

An announcement was placed in the Federal Register concerning the appointment of a committee to determine whether the automobile industry is technologically capable of designing and mass-producing a reliable engine that will meet the motor vehicle emissions standards prescribed by the Clean Air Act Amendments of 1970.

September 21, 1971

An announcement was placed in the Federal Register inviting public submissions of materials related to "technological feasibility" of meeting auto air emission standards.

July 6, 1972

An announcement was placed in the Federal Register requesting interested parties to obtain and fill out questionnaires concerning data or concepts on alternate engines for low emission automotive propulsion plants.

United States Court of Appeals

FOR THE DISTRICT OF COLUMBIA CIRCUIT

No. 72-1517

INTERNATIONAL HARVESTER COMPANY, PETITIONER

v.

WILLIAM D. RUCKELSHAUS, ADMINISTRATOR,
ENVIRONMENTAL PROTECTION AGENCY, RESPONDENT

No. 72-1525

GENERAL MOTORS CORPORATION, PETITIONER

v.

WILLIAM D. RUCKELSHAUS, ADMINISTRATOR,
ENVIRONMENTAL PROTECTION AGENCY, RESPONDENT

No. 72-1529

CHRYSLER CORPORATION,
A DELAWARE CORPORATION, PETITIONER

v.

WILLIAM D. RUCKELSHAUS, ADMINISTRATOR,
ENVIRONMENTAL PROTECTION AGENCY, RESPONDENT

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No. 72-1537

FORD MOTOR COMPANY, PETITIONER

v.

WILLIAM D. RUCKELSHAUS, ADMINISTRATOR, ENVIRONMENTAL PROTECTION AGENCY, RESPONDENT

Petition for Review of An order
Of the Administrator, Environmental Protection Agency

Decided February 10, 1973

Reuben L. Hedlund, of the Bar of the Supreme Court of Illinois, pro hac vice, by special leave of the Court, with whom *Lawrence Gunnels* was on the brief for petitioner in No. 72-1517.

Frederick M. Rowe with whom *Edward W. Warren, F. F. Hilder, William L. Weber, Jr.,* and *Hammond E. Chaffetz* were on the brief for petitioner in No. 72-1525.

John E. Nolan, Jr., with whom *Robert E. Jordan, III, William G. Christopher, Michael J. Malley, Richard H. Porter, Scott R. Schoenfeld* and *Victor C. Tomlinson* were on the brief for petitioner in No. 72-1529.

Howard P. Willens, with whom *Jay F. Lapin, William P. Hoffman, Jr., Gerald Goldman,* were on the brief for petitioner in No. 72-1537.

James A. Glasgow, Attorney, Department of Justice, with whom *Kent Frizzell,* Assistant Attorney General,

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Edmund B. Clark and *Raymond N. Zagone*, Attorneys, Department of Justice, were on the brief for appellee.

Jerome Maskowski was on the brief for State of Michigan, amicus curiae.

Before: BAZELON, *Chief Judge*, TAMM and LEVENTHAL, *Circuit Judges*.

Opinion for the Court filed by LEVENTHAL, *Circuit Judge*, in which *Circuit Judge* TAMM concurs.

Separate concurring Opinion filed by BAZELON, *Chief Judge* at p. 63.

LEVENTHAL, *Circuit Judge*: These consolidated petitions of International Harvester and the three major auto companies, Ford, General Motors and Chrysler, seek review [1] of a decision by the Administrator of the Environmental Protection Agency denying petitioners' applications, filed pursuant to Section 202 of the Clean Air Act,[2] for one year suspensions of the 1975 emission standards prescribed under the statute for light duty vehicles in the absence of suspension.

I. STATEMENT OF THE CASE

The tension of forces presented by the controversy over automobile emission standards may be focused by two central observations:

(1) The automobile is an essential pillar of the American economy. Some 28 per cent of the nonfarm workforce

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[1] Under Section 307 of the Clean Air Act, 42 U.S.C. § 1857h-5(b)(1), which provides for direct review of the Administrator's decision by the United States Court of Appeals for the District of Columbia Circuit (all citations are to the 1970 edition of the U.S. Code).

[2] 42 U.S.C. § 1857f-1(b)(5)(B).

draws its livelihood from the automobile industry and its products.[3]

(2) The automobile has had a devastating impact on the American environment. As of 1970, authoritative voices stated that "[a]utomotive pollution constitutes in excess of 60% of our national air pollution problem" and more than 80 per cent of the air pollutants in concentrated urban areas.[4]

A. *Statutory Framework*

Congressional concern over the problem of automotive emissions dates back to the 1950's,[5] but it was not until the passage of the Clean Air Act in 1965 that Congress established the principle of Federal standards for automobile emissions. Under the 1965 act and its successor, the Air Quality Act of 1967, the Department of Health, Education and Welfare was authorized to promulgate emission limitations commensurate with existing technological feasibility.[6]

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[3] Statement of Sen. Robert Griffin, 116 Cong. Rec. 33,081 (1970).

[4] For the 60% figure, *see* H. R. Rep. No. 91-1146, 91st Cong., 2d Sess., 6 (1970); for 64% national figure and the 80% urban figure, see statement of Nat'l Assoc. of Professional Engineers in Hearings on S. 3229, S. 3466, and S. 3546, before Subcomm. on Air and Water Pollution, Senate Comm. on Public Works, 91st Cong., 2d Sess., 114 (1970).

[5] The Act of July 14, 1955, Ch. 360, 1-7, 69 Stat. 322, authorized the Department of Health, Education and Welfare to provide research and assistance to local and state governments attempting to deal with air pollution. The Act of June 8, 1960, 74 Stat. 162, called for a federal study on the specific problem of automotive emissions.

[6] Motor Vehicle Air Pollution Control Act § 202(a), P.L. 89-272, Oct. 20, 1965, 79 Stat. 992 (Amendments to Clean Air Act); National Emission Standards Act § 202(a), P.L. 90-

The development of emission control technology proceeded haltingly. The Secretary of HEW testified in 1967 that "the state of the art has tended to meander along until some sort of regulation took it by the hand and gave it a good pull. . . . There has been a long period of waiting for it, and it hasn't worked very well." [7]

The legislative background must also take into account the fact that in 1969 the Department of Justice brought suit against the four largest automobile manufacturers on grounds that they had conspired to delay the development of emission control devices.[8]

On December 31, 1970, Congress grasped the nettle and amended the Clean Air Act to set a statutory standard for required reductions in levels of hydrocarbons (HC) and carbon monoxide (CO) which must be achieved for 1975 models of light duty vehicles. Section 202(b) of the Act. added by the Clean Air Amendments of 1970, provides that, beginning with the 1975 model year, exhaust emission of hydrocarbons and carbon monoxide from "light duty vehicles" must be reduced at least 90 per cent from the permissible emission levels in the 1970 model year.[9] In

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148, Nov. 21, 1967, 81 Stat. 499 (part of Air Quality Act of 1967).

[7] Hearings on Air Pollution—1967, Hearings before the Subcomm. on Air and Water Pollution, Sen. Comm. On Public Works, 90th Cong., 1st Sess., pt. 3, 1155-6 (1967).

[8] The suit was settled by consent decree. United States v. Automobile Manufacturers Ass'n., 307 F.Supp. 617 (C.D. Cal. 1969), *aff'd sub nom.* City of New York v. United States, *et al.*, 397 U.S. 248 (1970).

[9] 42 U.S.C. § 1857f-1(b)(A)(1) provides that "engines manufactured during or after model year 1975 shall contain standards which require a reduction of at least 90 per centum from emissions of carbon monoxide and hydrocarbons allowable under the standards . . . applicable to light duty vehicles and engines manufactured in model year 1970."

accordance with the Congressional directives, the Administrator on June 23, 1971, promulgated regulations limiting HC and CO emissions from 1975 model light duty vehicles to .41 and 3.4 grams per vehicle mile respectively. 36 Fed. Reg. 12,657 (1971).[10] At the same time, as required by section 202(b)(2) of the Act, he prescribed the test procedures by which compliance with these standards is measured.[11]

Congress was aware that these 1975 standards were "drastic medicine,"[12] designed to "force the state of the art."[13] There was, naturally, concern whether the manufacturers would be able to achieve this goal. Therefore, Congress provided, in Senator Baker's phrase, a "realistic escape hatch": the manufacturers could petition the Administrator of the EPA for a one-year suspension of the 1975 requirements, and Congress took the precaution of directing the National Academy of Sciences to undertake an ongoing study of the feasibility of compliance with the emission standards. The "escape hatch" provision addressed itself to the possibility that the NAS study or other evidence might indicate that the standards would be unachievable despite all good faith efforts at compliance. This provision was limited to a one-year suspension,

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[10] Section 1201.21 of this regulation also prescribes an oxides of nitrogen standard of 3.0 grams per vehicle mile for 1975. That standard has apparently not been challenged. In any event, it is not before us in the present case.

[11] "Emission standards under paragraph (1), and measurement techniques on which such standards are based (if not promulgated prior to December 31, 1970), shall be prescribed by regulation within 180 days after such date." 42 U.S.C. § 1857f-1(b)(2).

[12] Sen. Muskie, 116 Cong. Rec. 32,904 (1970).

[13] 116 Cong. Rec. 33,120 (1970) (newspaper report of statement of Senator Eagleton introduced into the record by Senator Muskie).

which would defer compliance with the 90% reduction requirement until 1976. Under section 202(b)(5)(D) of the Act, 42 U.S.C. § 1857f-1(b)(5)(D), the Administrator is authorized to grant a one-year suspension

> only if he determines that (i) such suspension is essential to the public interest or the public health and welfare of the United States, (ii) all good faith efforts have been made to meet the standards established by this subsection, (iii) the applicant has established that effective control technology, processes, operating methods, or other alternatives are not available or have not been available for a sufficient period of time to achieve compliance prior to the effective date of such standards, and (iv) the study and investigation of the National Academy of Sciences conducted pursuant to subsection (c) of this section and other information available to him has not indicated that such technology, processes, or other alternatives are available to meet such standards.

The statute provides that an application for suspension may be filed any time after January 1, 1972, and that the Administrator must issue a decision thereon within 60 days. On March 13, 1972, Volvo, Inc., filed an application for suspension and thereby triggered the running of the 60 day period for a decision. 37 Fed. Reg. 5766 (March 21, 1972).[14] Additional suspension requests were filed by International Harvester on March 31, 1972, and by Ford Motor Company, Chrysler Corporation, and General Motors Corporation on April 5, 1972. Public hearings were held from April 10-27, 1972. Representatives of most of the major vehicle manufacturers (in addition to the applicants), a number of suppliers of emission control devices

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[14] Evidently the Administrator decided to avoid separate suspension hearings for different applicants and awaited further filings which he anticipated. Volvo's application triggered the time period on the assumption that all applications were to be considered together. For the subsequent filings, *see* 37 Fed. Reg. 7039 (April 7, 1972).

and materials, and spokesmen from various public bodies and groups, testified at the hearings and submitted written data for the public record. The decision to deny suspension to all applicants was issued on May 12, 1972.

The Decision began with the statement of the grounds for denial: ". . . I am unable, on the basis of the information submitted by the applicants or otherwise available to me, to make the determinations required by section 202 (b)(5)(D)(i), (iii), or (iv) of the Act."[15] The EPA Decision specifically focused on requirement (iii) that:

> the applicant has established that effective control technology, processes, operating methods, or other alternatives are not available or have not been available for a sufficient period of time to achieve compliance prior to the effective date of such standards . . .,

A Technical Appendix, containing the analysis and methodology used by the Administrator in arriving at his decision, was subsequently issued on July 27, 1972.

B. *Initial Decision of the Administrator*

The data available from the concerned parties related to 384 test vehicles run by the five applicants and the eight other vehicle manufacturers subpoenaed by the Administrator. In addition, 116 test vehicles were run by catalyst and reactor manufacturers subpoenaed by the Administrator. These 500 vehicles were used to test five principal types of control systems: noble metal monolithic catalysts, base metal pellet catalysts, noble metal pellet catalysts, reactor systems, and various reactor/catalyst combinations.

At the outset of his Decision, the Administrator determined that the most effective system so far developed was

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[15] In re: Applications For Suspension of 1975 Motor Vehicle Exhaust Emission Standards, Decision of The Administrator, May 12, 1972 [hereinafter Decision], at 1.

the noble metal oxidizing catalyst.[16] Additionally, he stated that the "most effective systems typically include: improved carburetion; a fast-release choke; a device for promoting fuel vaporization during warm-up; more consistent and durable ignition systems; exhaust gas recirculation; and a system for injecting air into the engine exhaust manifold to cause further combustion of unburned gases and to create an oxidizing atmosphere for the catalyst." [17] It was this system to which the data base was initially narrowed: only cars using this kind of system were to be considered in making the "available technology" determination.

The problem the Administrator faced in making a determination that technology was available, on the basis of these data, was that actual tests showed only one car with actual emissions which conformed to the standard prescribing a maximum of .41 grams, per mile, of HC and 3.4 grams per mile of CO.[18] No car had actually been driven 50,000 miles, the statutory "useful life" of a vehicle and the time period for which conformity to the emission standards is required.[19] In the view of the EPA Adminis-

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[16] *Id.* at 14.

[17] *Id.*

[18] This was Chrysler car #333, but even this car had not been run 50,000 miles; and conformity with the 1975 standard depended on not taking into account certain emissions over the standards, claimed by the Administrator to be due to engine malfunction. *See* Appendix C to the Decision of the Administrator, Analysis of Vehicle Test Data [hereinafter Technical Appendix], at 17.

[19] 42 U.S.C. § 1857f-1(d) provides that "The Administrator shall prescribe regulations under which the useful life of vehicles and engines shall be determined . . . ." for purposes of the 1975 standards. "Such regulations shall provide that useful life shall—(1) in the case of light duty vehicles and light duty vehicle engines, be a period of use of five years or fifty thousand miles (or the equivalent), whichever first occurs . . . ."

trator, however, the reasons for the high test readings were uncertain or ambivalent.

Instead, certain data of the auto companies were used as a starting point for making a prediction, but remolded into a more useable form for this purpose. As the Administrator put it:[20]

> Much of the data reports emissions measured by test procedures different from the 1975 Federal test procedure and requires conversion to the 1975 procedure by calculations which cannot be regarded as precise. Emission data was frequently submitted without an adequate description of the vehicle being tested, the emission control systems employed, or the purpose of the test. The fuel and oil used in tests were not always specified. Adjustments made to components of the engine or emission control system were frequently made and seldom fully explained. In most cases, tests were not repeated, even where results departed significantly from established trends, and little or no information was submitted to explain the diagnosis of failure, where test results showed poor results. Most important, only a few test cars were driven to 20,000 miles or more, and no vehicle employing all components of any applicant's proposed 1975 control systems has yet been driven to 50,000 miles. *In the face of these difficulties, analysis and interpretation of the data required assumptions and analytical approaches which will necessarily be controversial to some degree.* (emphasis added)

In light of these difficulties, the Administrator "adjusted" the data of the auto companies by use of several critical assumptions.

First, he made an adjustment to reflect the assumption that fuel used in 1975 model year cars would either contain an average of .03 grams per gallon or .05 grams per gallon of lead.[21] This usually resulted in an increase of emis-

[20] Decision at 16-17.

[21] *Id.* at 18.

sions predicted, since many companies had tested their vehicles on lead free gasoline.

Second, the Administrator found that the attempt of some companies to reduce emissions of nitrogen oxides below the 1975 Federal standard of 3.0 grams per vehicle mile [22] resulted in increased emissions of hydrocarbons and carbon monoxide. This adjustment resulted in a downward adjustment of observed HC and CO data, by a specified factor.[23]

Third, the Administrator took into account the effect the "durability" of the preferred systems would have on the emission control obtainable. This required that observed readings at one point of usage be increased by a deterioration factor (DF) to project emissions at a later moment of use. The critical methodological choice was to make this adjustment from a base of emissions observed at 4000 miles. Thus, even if a car had actually been tested over 4000 miles, predicted emissions at 50,000 miles would be determined by multiplying 4000 mile emissions by the DF factor.[24]

Fourth, the Administrator adjusted for "prototype-to-production slippage." This was an upward adjustment made necessary by the possibility that prototype cars might have features which reduced HC and CO emissions, but were not capable of being used in actual production vehicles.[25]

Finally, in accord with a regulation assumed, as to substance, in the text of the Decision, but proposed after the

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[22] *See* note 10 *supra*.

[23] Decision at 18.

[24] *Id.* The choice of 4000 mile emissions as a base point corresponds to certification testing procedures. 37 Fed. Reg. 24,250, 24,263 (1972), § 85.073-28.

[25] Decision at 20.

suspension hearing,[26] a downward adjustment in the data readings was made on the basis of the manufacturers' ability, in conformance with certification procedures, to replace the catalytic converter "once during 50,000 miles of vehicle operation," a change they had not used in their testing.[27]

With the data submitted and the above assumptions, the Administrator concluded that no showing had been made that requisite technology was not available. The EPA noted that this did not mean that the variety of vehicles produced in 1975 would be as extensive as before. According to EPA, "Congress clearly intended to require major changes in the kinds of automobiles produced for sale in the United States after 1974" and there "is no basis, therefore, for construing the Act to authorizing suspension of the standards simply because the range of performance of cars with effective emission control may be restricted as compared to present cars." As long as "basic demand" for new light duty motor vehicles was satisfied, the applicants could not establish that technology was not available.[28]

For purposes of judicial review, the initial EPA decision rests on the technology determination. The Administrator did state: [29]

> On the record before me, I do not believe that it is in the *public interest* to grant these applications, where compliance with 1975 standards by application of present technology can probably be achieved, and where ample additional time is available to manufacturers to apply existing technology to 1975 vehicles. (Emphasis added.)

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[26] 37 Fed. Reb. 23,778 (November 8, 1972).

[27] Decision at 20.

[28] *Id.* at 9.

[29] *Id.* at 30.

The statute apparently contemplates the possibility of an EPA denial of suspension for failure to meet criterion (i) of § 202(b)(5)(D) ("essential to the public interest") even though criterion (iii) has been satisfied ("applicant has established that effective control technology . . . [is] not available").[30] It suffices here to say that the EPA's 1972 "public interest" finding was obviously only a restatement of, and dependent on the validity of, the conclusion of a failure to satisfy standard (iii) by showing that effective control technology is not available.

The Administrator also offered some "comments" on issues pertinent to the required "good faith" determination under standard (ii), as guidance to applications who might seek a one year suspension next year of the 1976 oxides of nitrogen standard. But he explicitly disclaimed reaching that question in this proceeding. The thrust of his comment was to call into question the rigid "arms length" relationship structure which vehicle manufacturers imposed on their suppliers, as a source of a halter on progress in developing the required technology.[31]

C. *This Court's December 1972 Remand*

After oral argument to this court on December 18, 1972, in a per curiam order issued December 19, 1972, we remanded the record to the Administrator, directing him to supplement his May 12, 1972 decision by setting forth:

(a) the consideration given by the Administrator to the January 1, 1972 Semiannual Report on Techno-

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[30] See Part III of the opinion where factors which might properly enter into such a determination are discussed.

[31] The Administrator noted, however, that the "closest working relationship between a vehicle manufacturer and a catalyst company that has been brought to my attention has been the Ford technical interchange arrangement with Englehard." Decision at 26.

logical Feasibility of the National Academy of Sciences; and (b) the basis for his disagreement, if any, with the findings and conclusion in that study concerning the availability of effective technology to achieve compliance with the 1975 model year standards set forth in the Act.

Our remand order was not intended to indicate that we had concluded that an EPA conclusion was required as to clause (iv)—concerning the evaluation based on the NAS study and other information (from sources other then applicants)—when the Administrator had determined under (iii) that the auto companies had not shown technology was not available. We were nevertheless troubled by arguments advanced by petitioners that the methodology used by the Administrator in reaching his conclusion, and indeed the conclusion itself, was inconsistent with that of the Academy. It was our view that if and to the extent such differences existed they should be explained by EPA, in order to aid us in determining whether the Administrator's conclusion under (iii) rested on a reasoned basis.

D. *Supplement to the Decision of the Administrator*

Our remand of the record resulted in a "Supplement to Decision of the Administrator" issued December 30, 1972. The Administrator in his Supplement stated that "In general I consider the factual findings and technical conclusions set forth in the NAS report and in the subsequent Interim Standards Report dated April 26, 1972 . . . to be consistent with my decision of May 12, 1972." [32]

The Report made by the NAS, pursuant to its obligation under 202(b)(5)(D) of the Clean Air Act, had concluded:

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[32] In re: Applications For Suspension of 1975 Motor Vehicle Exhaust Emission Standards, Supplement to Decision of the Administrator, December 30, 1972 [hereinafter Supplement to Decision] at 1.

"The Committee finds that the technology necessary to meet the requirements of the Clean Air Act Amendments for 1975 model year light-duty motor vehicles is not available at this time." [33]

The Administrator apparently relied, however, on the NAS Report to bolster his conclusion that the applicants had not established that technology was unavailable. The same NAS Report had stated: [34]

> . . . the status of development and rate of progress made it possible that the larger manufacturers will be able to produce vehicles that will qualify, provided that provisions are made for catalyst replacement and other maintenance, for averaging emissions of production vehicles, and for the general availability of fuel containing suitably low levels of catalyst poisons.

The Administrator pointed out that two of NAS's provisos—catalytic converter replacement and low lead levels—had been accounted for in his analysis of the auto company data, and provision therefor had been insured through regulation.[35] As to the third, "averaging emissions of production vehicles," [36] the Administrator offered two reasons for declining to make a judgment about this matter: (1) The significance of averaging related to possible assembly-line tests, as distinct from certification test procedure, and such tests had not yet been worked out. (2) If there were an appropriate assembly-line test it would be expected that each car's emissions could be in conformity,

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[33] Committee on Motor Vehicle Emissions, National Academy of Sciences, Semiannual Report to the Environmental Protection Agency, January 1, 1972 [hereinafter NAS Report] at 49.

[34] *Id.*

[35] Supplement to Decision at 2-3.

[36] *Id.* at 3-4.

without a need for averaging, since the assembly line vehicles "equipped with fresh catalysts can be expected to have substantially lower emissions at zero miles than at 4000 miles." [37]

The Administrator also claimed that he had employed the same methodology as the NAS used in its Interim Standards Report, evidently referring to the use of 4000 mile emissions as a base point, and correction for a deterioration factor and a prototype-production slippage factor.[38] The identity of methodology was also indicated, in his view, by the fact the EPA and NAS both agreed on the component parts of the most effective emission control system.

The Administrator did refer to the "severe driveability problems" underscored by the NAS Report, which in the judgment of NAS "could have significant safety implications," [39] stating that he had not been presented with any evidence of "specific safety hazard" nor knew of any presented to the NAS. He did not address himself to the issue of performance problems falling short of specific safety hazards.

II. REJECTION OF MANUFACTURERS' GENERAL CONTENTIONS

We begin with consideration, and rejection, of the broad objections leveled by petitioners against EPA's overall approach.

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[37] *Id.* at 4, quoting from Decision at 11.

[38] *See* Committee on Motor Vehicle Emissions, National Academy of Sciences, Interim Standards Report, April 26, 1972 [hereinafter Interim Standards Report].

[39] NAS Report at 30.

A. *Future Technological Developments*

We cannot accept petitioners' arguments that the Administrator's determination whether technology was "available," within the meaning of section 202(b)(5)(D) of the Act, must be based solely on technology in being as of the time of the application, and that the requirement that this be "available" precludes any consideration by the Administrator of what he determines to be the "probable" or likely sequence of the technology already experienced. Congress recognized that approximately two years' time was required before the start of production for a given model year, for the preparation of tooling and manufacturing processes.[40] But Congress did not decide—and there is no reason for us to do so—that all development had to be completed before the tooling-up period began. The manufacturers' engineers have admitted that technological improvements can continue during the two years prior to production.[41] Thus there was a sound basis for the Administrator's conclusion that the manufacturers could "improve, test, and apply" technology during the lead time period.[42]

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[40] Although various estimates were made during the debate, the consensus seemed to be that two years is the most reasonable estimate. This was apparently the understanding of the Conference Committee. *See* 116 Cong. Rec. 42,522 (1970) (Rep. Staggers, Manager on the part of the House).

[41] In testimony before the Administrator, Ford's Vice President for Engineering and Manufacturing identified as the "last date for incorporation of proven new technology" November 1, 1973—16 months after the start of the tooling-up period. He testified that the companies could be "developing engineering solutions" until that date. Hearing Tr. at 1916; *cf. id.* at 2033-4. Cf. Statement of Lee A. Iacocca in Hearings on S. 3229, S. 3446, S. 3546, before Subcomm. on Air and Water Pollution, Senate Comm. on Public Works, 91st Cong., 2d Sess., pt. 5, 1620-21 (1970).

[42] Decision at 29.

The petitioners' references to the legislative history are unconvincing. None of the statements quoted in their briefs specifically states that "available" as used in the statute means "available in 1972." There is even comment that points to a contrary interpretation.[43] In any event, we think the legislative history is consistent with the EPA's basic approach and evidences no ascertainable legislative intent to the contrary.

While we reject the contention as broadly stated, principally by General Motors, we hasten to add that the Administrator's latitude for projection is subject to the restraints of reasonableness, and does not open the door to "'crystal ball' inquiry."[44] The Administrator's latitude for projection is unquestionably limited by relevant considerations of lead time needed for production.[45] Implicit also is a requirement of reason in the reliability of the EPA projection. In the present case, the Administrator's prediction of available technology was based on known elements of existing catalytic converter systems. This was a permissible approach subject, of course, to the requirement that any technological developments or refinements of existing systems, used as part of the EPA methodology, would have to rest on a reasoned basis.

B. *Claimed Right of Cross-Examination*

Chrysler has advanced a due process claim based upon two principal features of the proceeding, the inability to

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[43] *See* 116 Cong. Rec. 33,086-87 (1970) (Statement of Senator Gurney).

[44] National Resources Defense Council, Inc. v. Morton, 148 U.S.App.D.C. 5, 15, 458 F.2d 827, 837 (1972).

[45] Remarks of Senator Gurney, 116 Cong. Rec. 33,086 (1970).

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engage in cross-examination and the inability to present arguments against the methodology used in the Technical Appendix of the Administrator, which served as a basis for his decision.

The suspension provision of Section 202(b)(5)(D) does not require a trial type hearing. It provides:

> Within 60 days after receipt of the application for any such suspension, and after public hearing, the Administrator shall issue a decision granting or refusing such suspension.

First, this provision for a "public hearing" contrasts significantly with other provisions that specifically require an adjudicatory hearing.[46] More importantly, the non-adjudicatory nature of the "public hearing" contemplated is underscored by the 60 day limit for a decision to be made. The procedure contemplated by Congress in its 1970 legislation must be appraised in light of its concern with "avoidance of previous cumbersome and time consuming procedures," *see* Kennecott Copper Corp. v. EPA, —— U.S.App.D.C. ——, ——, 462 F.2d 846, 849 (1972).

As to legislative history of this provision, the starting point is the provision in Senate Bill 4358:[47]

> Upon receipt of such application, the Secretary shall promptly hold a public hearing to enable such manufacturer or manufacturers to present information relevant to the implementation of such standard. The Secretary, in his discretion, may permit any interested

[46] For instances in the Act where adjudicatory hearings are called for, see § 110(f) (2), 42 U.S.C. § 1857c-5(f) (2) (hearing on one-year postponement of a plan requirement on application of State Governor); § 206(b) (2) (B), 42 U.S.C. § 1857f-5(b) (2) (B) (hearing on suspension or revocation of motor vehicle certifications). Both determinations must be made "on the record".

[47] *See* S.4358, 91st Cong. 2d Sess., printed in S.Rep. No. 91-1196 91st Cong., 2d Sess. 103 (1970).

person to intervene to present information relevant to the implementation of such standard.

This was dropped in conference, along with a provision permitting six months for a suspension decision. The resulting legislation both expedited the decision-making, and contemplated EPA solicitation of a wide range of views, from sources other than the auto companies, though the companies' applications and presentation would surely be the focus of consideration. Underlying this approach of both shortening time for decision and enlarging input lies, we think, an assumption of an informative but efficient procedure without mandate for oral cross examination.

In context, the "public hearing" provision amounts to an assurance by Congress that the issues would not be disposed of merely on written comments, the minimum protection assured by the Administrative Procedure Act for rule-making, but would also comprehend oral submissions of a legislative nature. These are required even for rule-making when "controversial regulations governing competitive practices" are involved. American Airlines, Inc. v. CAB, 123 U.S.App.D.C. 310, 317, 359 F.2d 624, 631 (en banc 1966), *cert. denied,* 385 U.S. 843 (1966); Walter Holm & Co. v. Hardin, 145 U.S.App.D.C. 347, 449 F.2d 1009 (1971). Even assuming oral submission, in a situation where "general policy" is the focal question, a legislative-type hearing is appropriate.[48]

[48] *See* United States v. Florida East Coast R. Co., —— U.S. —— (Slip Opin. 70-279, January 22, 1973) where the Court held that rule-making hearings, under 5 U.S.C. § 553, are sufficient where the agency's statute provides for a "hearing." The provision of 5 U.S.C. § 556(d) which gives the opportunity for cross-examination as a matter of right, would only be automatically applicable if "rules are required by statute to be made *on the record* after opportunity for an agency hearing . . . ." (emphasis added). Without the precise

A complication is presented by the case before us in that the general policy questions became interfused with relatively specific technical issues. Yet within the context of a quasi-legislative hearing and the time constraints of the statute, we do not think the absence of a general right of cross-examination on the part of the companies was a departure from "basic considerations of fairness." Walter Holm & Co. v. Hardin, *supra,* 145 U.S.App.D.C. at 354, 449 F.2d at 1016. Hearings ran for two weeks and a wide range of participants was included within the proceeding: manufacturers, vendors of the control devices and public interest groups. The auto companies were allowed to submit written questions to the Hearing Panel to be asked to various witnesses. Opportunity to prepare written questions is not as satisfactory to counsel as the opportunity to proceed on oral cross-examination, with questions that develop from previous answers. But examination on interrogatories has long been used in the law when necessary, albeit second best. And interrogatories to a live witness—often arranged in private lawsuits by use of a commission—avoid the peril of "canned" affidavits and counsel-assisted, or even counsel-drafted, responses to interrogatories. Their availability was a reasonable attempt by EPA to elicit the facts and at the same time cope with the time constraints. We do not think more was required. There was a meaningful opportunity to be heard. The specific nature of a "hearing" varies with circumstances. Cafeteria & Restaurant Workers Union v. McElroy, 367 U.S. 886, 895 (1961), cited with approval in Goldberg

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words "on the record," § 556 does not automatically apply. Slip opinion at 14.

The words "on the record" are not incoporated into Section 202(b)(5)(D). Only a "public hearing" is required. Moreover, subsection (iv) of that provision allows consideration by the Administrator of "other information available to him" in reaching a conclusion on "available technology."

v. Kelly, 397 U.S. 254, 263 (1970). Whether particular attributes of forensic presentation are not only salutary but also mandatory must also depend on circumstances. The heft of the hearing problem, including the time constraints on decisions, convinces us that the assertion of a broad right of cross-examination cannot be successfully maintained.

We distinguish between the assertion of a broad right of cross-examination, such as that argued to this court, and a claim of a need for cross-examination of live witnesses on a subject of critical importance which could not be adequately ventilated under the general procedures. This is the kind of distinction that this court made in its en banc opinion in American Airlines v. CAB, *supra,* 123 U.S.App. D.C. at 318-19, 359 F.2d at 632-33. We see no principled manner in which firm time limits can be scheduled for cross-examination consistent with its unique potential as an "engine of truth"—the capacity given a diligent and resourceful counsel to expose subdued premises, to pursue evasive witnesses, to "explore" the whole witness, often traveling unexpected avenues.

Given the variances in counsel, the reality that seasoning and experience are required even for trial judges who seek to avoid repetitive and undue cross-examination, the enhancement of difficulties encountered with the breadth of issues involved in a "public interest" proceeding, the fairly-anticipated problem of provision for redirect (and re-cross) and the interplay of different cross-examinations, there is a not insignificant potential for havoc. What is most significant is that these complications are likely to be disproportionate to the values achieved, in a proceeding focusing on technical matters where other techniques generally are sufficient to adduce the pertinent information as to both what is known and unknown.

In context, we consider that the technique, adopted by

EPA, of pre-screening written questions submitted in advance is reasonable and comports with basic fairness as the general procedure. This approach permits screening by the hearing officer so as to avoid irrelevance and repetition, permits a reasonable estimate of the time required for the questioning, and aids scheduling and allocation of available time among various participants and interests.[49] The record reveals that the hearing officers did not propound the pre-submitted questions like robots; they were charged with conducting a hearing for the purpose of focusing information needed for decision, and they quite appropriately "followed up" on questions.

We revert to our observation that a right of cross-examination, consistent with time limitations, might well extend to particular cases of need, on critical points where the general procedure proved inadequate to probe "soft" and sensitive subjects and witnesses. No such circumscribed and justified requests were made in this proceeding.

C. *Right To Comment on EPA Methodology*

A more serious problem, at least from the point of an informed decision-making process, is posed by the inability of petitioners to challenge the methodology of EPA at the hearing. In other contexts, it is commonplace for administrative proceedings to focus in detail on agency methodology,[50] and such elucidation is salutary, of particular aid to a reviewing court. Again, however, we cannot ignore the problem of time. In part, EPA developed

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[49] The procedure adopted may be justified, in part, on grounds like those supporting voir dire by the trial judge, using questions submitted by counsel. *See* United States v. Bryant, Slip Opin. No. 23,746 (D.C. Cir. April 21, 1972).

[50] *E.g.*, Permian Basin Area Rate Cases, 390 U.S. 747 (1968).

its methodology on the basis of submissions made by the companies at the hearings, as to the parameters of its various data. The requirement of submission of a proposed rule for comment does not automatically generate a new opportunity for comment merely because the rule promulgated by the agency differs from the rule it proposed, partly at least in response to submissions.[51] Given the circumstances, we cannot hold the absence of the right to comment on the methodology a violation of the statute or due process, though such opportunity would certainly have been salutary.

While the statute makes no express provision therefor, we assume that Congress contemplated a flexibility in the administrative process permitting the manufacturers to present to EPA any comments as to its methodology, in a petition for reconsideration or modification. However, this opportunity does not permit invocation of the doctrine of failure to exhaust administrative remedies as a bar to these appeals, for those petitions could not have affected

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[51] A contrary rule would lead to the absurdity that in rule-making under the APA the agency can learn from the comments on its proposals only at the peril of starting a new procedural round of commentary.

As we have stated in an analogous context of rule-making proceedings before the Federal Communications Commission, where petitioners have argued that the Commission was "changing the rules in the middle of the game" when it took into consideration factors not specifically indicated in its Section 4(a) notice under the Administrative Procedure Act, 5 U.S.C. § 1001(a), "[s]urely every time the Commission decided to take account of some additional factor it was not required to start the proceedings all over again. If such were the rule the proceedings might never be terminated." Owensboro On the Air v. U.S., 104 U.S.App.D.C. 391, 397; 262 F.2d 702, 708 (1958); Logansport Broadcasting Corp. v. United States, 93 U.S.App.D.C. 342, 346, 210 F.2d 24, 28 (1954).

or deferred the finality of the EPA decision or the time for seeking judicial review. The opportunity is noted to obviate any possibility that the law, or our comments, may be misunderstood to require a rigid procedure of prompt and unshakeable decision-making. Our own December remand requesting clarification of the Decision illustrates that while this statute imposes some unusual time restraints it does not jettison the flexibility and capacity of reexamination that is rooted in the administrative process. American Airlines v. CAB, *supra,* 123 U.S.App.D.C. at 319; 359 F.2d at 633.

As matters have shaped up, the central technical issue on this appeal concerns the reliability of EPA's methodology. While we do not say that the failure to provide reasonable opportunity to comment on EPA methodology invalidates the EPA Decision for lack of procedural due process, or similar contention, we must in all candor accompany that ruling with the comment that the lack of such opportunity has had serious implications for the court given the role of judicial review.

We shall subsequently develop the legal questions, primarily questions of EPA's burden of proof, that arise with respect to EPA methodology. We preface these with admission of our doubts and diffidence. We are beset with contentions of petitioners that bear indicia of substantiality. Yet we have no EPA comment on the specific questions raised, apart from some discussion by counsel which is not an adequate or appropriate substitute.[52] Our December 1972 remand opened the door to a candid discussion of these matters, but EPA fashioned a carefully limited response.

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[52] Burlington Truck Lines v. United States, 371 U.S. 156, 168-9 (1962); Braniff Airways, Inc. v. CAB, 126 U.S.App. D.C. 399, 411, 379 F.2d 453, 465 (1967).

The EPA might have indicated that it desired to take a fresh look at its methodology on the basis of petitioners' criticisms, in which case, on an adaptation of the *Smith v. Pollin*[53] procedure, this court might have remanded the case to the agency. This remand would come during the course of our judicial review and would not conflict with the 60 day statutory time limit for the hearing and decision on the applications for suspension.

Indeed, the fact that the Administrator issued the Technical Appendix almost three months after his Decision, at a time when judicial review had already begun to run its course, indicates that the agency did not believe that agency consideration was frozen from the moment that the suspension decision was rendered, a view we approve. The EPA had latitude to continue further consideration even without requesting a court remand (under *Smith v. Pollin*) that would suspend judicial consideration.

III. OVERALL PERSPECTIVE OF SUSPENSION ISSUE

This case ultimately involves difficult issues of statutory interpretation, as to the showing required for applicants to sustain their burden that technology is not available. It also taxes our ability to understand and evaluate technical issues upon which that showing, however it is to be defined, must rest. At the same time, however, larger questions are at stake. As Senator Baker put it, "This may be the biggest industrial judgment that has been made in the United States in this century." 116 Cong. Rec. 33,085 (1970). This task of reviewing the suspension decision was not assigned to us lightly. It was the judgment of Congress that this court, isolated as it is from political

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[53] 90 U.S.App.D.C. 178, 194 F.2d 349 (1952). *See also* Greater Boston Television Corp. v. FCC, —— U.S.App.D.C. ——, 463 F.2d 268(1971).

pressures, and able to partake of calm and judicious reflection would be a more suitable forum for review than even the Congress.[54]

Two principal considerations compete for our attention. On the one hand, if suspension is not granted, and the prediction of the EPA Administrator that effective technology will be available is proven incorrect, grave economic consequences could ensue. This is the problem Senator Griffin described as the "dangerous game of economic roulette." 116 Cong. Rec. 33,081 (1970). On the other hand, if suspension is granted, and it later be shown that the Administrator's prediction of feasibility was achievable in 1975 there may be irretrievable ecological costs. It is to this second possibility to which we first turn.

A. *Potential Environmental Costs*

The most authoritative estimate in the record of the ecological costs of a one-year suspension is that of the NAS Report. Taking into account such "factors as the vehicle-age distribution among all automobiles, the decrease in vehicle miles driven per year, per car as vehicle age increases, the predicted nationwide growth in vehicle miles driven each year" and the effect of emission standards on exhaust control, NAS concluded that:[55]

> . . . the effect on total emissions of a one-year suspension with no additional interim standards appears to be small. The effect is not more significant because the emission reduction now required of model year 1974 vehicles, as compared with uncontrolled vehicles

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[54] An amendment to Senate Bill 4358 proposed by Senator Dole of Kansas, which would have made the suspension decision reviewable by Congress instead of the court, as proposed by the Committee, 116 Cong. Rec. 33,078 (1970), was rejected by the Senate, 116 Cong. Rec. 33,089 (1970).

[55] NAS Report at 45-48.

(80 percent for HC and 69 percent for CO), is already so substantial.

Other considerations may diminish the costs even further. There seems to be agreement that there are performance costs for automobiles in employing pollution control devices, even if the effects on performance cannot fairly be characterized as constituting safety hazards. The NAS Report summarized the problem, as follows:[56]

> Three areas of vehicle performance are likely to be adversely affected by the 1975 emission control systems. These are fuel economy, vehicle-acceleration capability, and vehicle driveability (or ability to perform adequately in all normal operating modes and ambient conditions).

The question in this context is not whether these are costs the consumer should rightly bear if ecological damage is to be minimized, but rather the general effect on consumer purchasing of 1975 model year cars in anticipation of lower performance. A drop-off in purchase of 1975 cars will result in a prolonged usage of older cars with *less* efficient pollution control devices. If the adverse performance effect deterred purchasing significantly enough, resulting in greater retention of "older" cars in the "mix" of cars in use, it might even come to pass that total actual emissions (of all cars in use) would be greater under the 1975 than the 1974 standards.

Many of the anticipated performance problems are traceable to the systems introduced to conform cars to control of nitrogen oxides to achieve prescribed 1975 standards, by use of exhaust-gas recycle (EGR). Such systems affect vehicle-acceleration capability because the power output for a given engine displacement, engine speed, and throttle setting is reduced.[57] The NAS Report indicates that such

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[56] *Id.* at 29.

[57] *Id.*

systems could result in direct fuel-economy penalties of up to 12 percent compared with 1973 prototype vehicles.[58]

The NAS Report states that the effects of emission controls on vehicle driveability are difficult to quantify, but nevertheless makes the following qualitative evaluation:[59]

> Driveability after a cold-engine start, and especially with cold ambient conditions, is likely to be impaired. To reduce HC and CO emissions during engine warm-up, the choke is set to release quickly, and the fuel-air mixture is leaned out as early as possible after engine startup. Under these conditions, problems of engine stall, and vehicle stumble and hesitation on rapid acceleration, have been prevalent.

The willingness of the consumer to buy 1975 model year cars may also be affected, to some degree, by the anticipated significant costs of pollution control devices. The problem is further bedeviled by the possibility that consumers, albeit rightly assigned the cost burden of pollution devices, may seek to avoid that burden, however modest,[60] and to exercise, at least in some measure, an option to use older cars. Again, this would have the thrust of increasing actual total emissions of cars in use.

We may also note that it is the belief of many experts—both in and out of the automobile industry—that air pollution cannot be effectively checked until the industry

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[58] *Id.*

[59] *Id.* at 30.

[60] The NAS estimated an increase in initial cost of about $214, *Id.* at 42, over the 1973-74 model year system, and $288 over the 1970 system. To this must be added the EPA assumption of at least one catalytic converter replacement during 50,000 miles of vehicle operation, *see* text at note 35, *supra,* and the possibility that considerable maintenance may be needed to keep converters at required level of efficient operation.

finds a substitute for the conventional automotive power plant—the reciprocating internal combustion (*i.e.*, "piston") engine.[61] According to this view, the conventional unit is a "dirty" engine. While emissions from such a motor can be "cleaned" by various thermal and catalytic converter devices, these devices do nothing to decrease the production of emissions in the engine's combustion chambers. The automobile industry has a multi-billion-dollar investment in the conventional engine, and it has been reluctant to introduce new power plants or undertake major modifications of the conventional one.[62] Thus the bulk of the industry's work on emission control has focussed narrowly on converter devices. It is clear from the legislative history that Congress expected the Clean Air Amendments to force the industry to broaden the scope of its research—to study new types of engines and new control systems.[63] Perhaps even a one-year suspension does not give the industry sufficient time to develop a new approach to emission control and still meet the absolute deadline of 1976. If so, there will be ample time for the EPA and Congress, between now and 1976 to reflect on changing the statutory approach. This kind of cooperation, a unique three-way partnership

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[61] *See, e.g.*, U.S. General Accounting Office, Report to the Congress: Cleaner Engines for Cleaner Air, at 45-47 (May 15, 1972) (hereinafter "G.A.O. Report"); statement of Fred C. Hart, New York City Environmental Protection Agency, in Implementation of the Clean Air Act Amendments of 1970, Hearings before the Subcomm. on Air and Water Pollution, Senate Comm. on Public Works, 92nd Cong., 2d Sess., pt. 3, 1597 (1972).

[62] The General Accounting Office reported in 1972 that the industry was "entrenched" in efforts to retain the conventional engine. G.A.O. Report at 45.

[63] 116 Cong. Rec. 32,906 (1970) (Sen. Muskie); H.R. Rep. No. 91-1146, 91st Cong., 2d Sess. 6 (1970).

between the legislature, executive and judiciary, was contemplated by the Congress[64] and is apparent in the provisions of the Act.[65]

The NAS estimated that there would be a small environmental cost to suspension of 1975 standards even if 1974 standards were retained, but further recommended intermediate standards that would dilute even such modest environmental cost.[66] The following table shows the various standards, and one put forward by Ford for 1975:

	Maximum emissions (grams per mile)	
	HC	CO
1974 standards	3.4	39.0
Ford proposal	1.6	19.0
NAS recommendation for Intermediate standards:		
No catalyst change	1.1	8.2
One catalyst change	0.8	6.3
1975 Standards	.41	3.4

[64] Congress made clear that it would be ready to exercise its right to intervene if it did not agree with the results its statutory "shock treatment" produced. *See* 116 Cong. Rec. 32,905 (1970) (Senator Muskie). Congress, through Oversight Hearings conducted by the Subcommittee on Air and Water Pollution of the United States Senate, continues to keep a watchful eye on the implementation of the Act. *See* Implementation of the Clean Air Act Amendments of 1970, Hearings before the Subcomm. on Air and Water Pollution, Senate Comm. on Public Works, 92d Cong., 2d Sess., pts. 1-3 (1972).

[65] The Act provides for various progress reports to be made by the Administrator to the Congress, 42 U.S.C. § 1857j-1 and 2. Additional information is supplied by the Semiannual Reports of the National Academy of Sciences. 42 U.S.C. § 1857f-1(c). More particularly, the Act provides, 42 U.S.C. § 1857f-1(b) (4), for the EPA to make "recommendations for additional congressional action" which he deems advisable.

[66] Interim Standards Report at 8.

Our concern that the 1975 standards may possibly be counter-productive, due to decreased driveability and increased cost, is not to be extrapolated into a caution against any improvement, and concomitant reduction in permitted emissions. In such matters, as the NAS recommendation for interim standards implicitly suggests, a difference in degree may be critical, and the insistence on absolute 1975 standards, without suspension or intermediate level, may stretch for the increment that is essentially counter-productive.

We also observe that Ford Motor Company is on record as to capability of greater emission controls, *i.e.*, lower level of emissions, than those permitted for 1974 model year cars,[67] and Ford proposed that, given certain regulatory assumptions,[68] the Administrator adopt an interim standard of 1.6 gm/mi HC and 19.0 gm/mi CO levels, about one half those permitted for the 1974 model year cars.

On balance the record indicates the environmental costs of a one-year suspension are likely to be relatively modest. This must be balanced against the potential economic costs— and ecological costs—if the Administrator's prediction on the availability of effective technology is incorrect.

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[67] JA at 954-59; Doc. No. 135, Vol. II at 5-18 to 5-23.

[68] Ford's proposals were qualified by the following regulatory assumptions: (1) maximum lead grams per gallon of gasoline .03; (2) averaging of emissions for certification test procedures; (3) a methane allowance in interpreting hydrocarbon data; and (4) reasonable maintenance on durability test cars used in determining certification. Only the reasonable maintenance assumption corresponds to actual EPA regulations now in effect or proposed. Doc. No. 135, Vol. II, at 5-28 to 5-33.

B. *Potential Economic Costs*

Theoretical possibility of industry shutdown

If in 1974, when model year 1975 cars start to come off the production line, the automobiles of Ford, General Motors and Chrysler cannot meet the 1975 standards and do not qualify for certification, the Administrator of EPA has the theoretical authority, under the Clean Air Act, to shut down the auto industry, as was clearly recognized in Congressional debate.[69] We cannot put blinders on the facts before us so as to omit awareness of the reality that this authority would undoubtedly never be exercised, in light of the fact that approximately 1 out of every 7 jobs in this country is dependent on the production of the automobile.[70] Senator Muskie, the principal sponsor of the bill, stated quite clearly in the debate on the Act that he envisioned the Congress acting if an auto industry shutdown were in sight.[71]

The economic consequence of an approach geared to stringency, relying on relaxation as a safety valve

A more likely forecast, and one which enlightens what influenced the EPA decision to deny the suspension, was articulated by George Allen, Deputy Assistant Administrator for General Enforcement and a member of EPA's Hearing Panel:[72]

> The problem really comes down to this: A decision has to be made next month, early next month. If the

[69] 116 Cong. Rec. 32,905 (1970).

[70] Estimate provided by Senator Griffin, 116 Cong. Rec. 32,906 (1970).

[71] 116 Cong. Rec. 32,905 (1970).

[72] Transcript at 2034-35.

> decision is to suspend the standards and adopt an interim standard . . . and in 1975 it turns out that technology exists to meet the statutory standard, today's decision turns out to be wrong.
>
> * * *
>
> If, on the other hand, a decision is made today that the standards cannot lawfully be suspended, and we go down to 1975 and nobody can meet the standard, today's decision was wrong.
>
> In [the first] case, there is not much to do about the wrong decision; it was made, many people relied on it; it turns out the standard could have been met, but I doubt if we could change it.
>
> In the second case, if a wrong decision is made, there is probably a remedy, a re-application and a recognition by the agency that it is not technically feasible to meet the standards. You can correct the one; you probably can't correct the other.

Grave problems are presented by the assumption that if technical feasibility proves to be a "wrong decision" it can be remedied by a relaxation.

Certain techniques available to the Administrator, through changes in the certification procedure, can be used in an even handed manner for all three auto companies to facilitate compliance with the 1975 standards. Already lower lead levels in fuel available for 1975 model year cars have been prescribed to increase the efficiency of the catalytic converter. Similarly certain changes in the regulatory system, through allowable maintenance and permitted change in the catalytic converter, have been made by EPA. These techniques work with reasonable impartiality as to the various auto companies.

However, a relaxation of standards, and promulgation of an interim standard, at a later hour—after the base hour for "lead time" has been passed, and the production sequence set in motion—forebodes quite different consequences. The record before us suggests that there already exists a technological gap between Ford and General Motors,[73] in Ford's favor. General Motors did not make the decision to concentrate on what EPA found to be the most effective system at the time of its decision—the noble metal monolithic catalyst. Instead it relied principally on testing the base metal catalyst as its first choice system.[74] In predicting that General Motors could meet the 1975 standards, EPA employed a unique methodological approach. Instead of taking emissions at 4000 miles of cars with preferred systems—with which none of the General Motors care was equipped—and applying against this, adjustments for lead levels and deterioration, as had been done in the case of Ford and Chrysler, EPA took emissions at 4000 miles of GM cars which had no converters of any kind, and predicted how they would function with an Engelhard monolithic catalytic converter, based on auto manufacturers' use of this device in a number of cars—principally Ford's—when testing it for durability.[75] In his Supplemental Decision the Administrator recognized that this was a departure from NAS methodology, stating:[76]

> In its Interim Standards Report the National Academy recommended a methodology for predicting the emission levels achievable by manufacturers. This recommended methodology is the same methodology that was employed in the technical appendix to my

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[73] For purposes of a comparison, Chrysler is omitted from this comparison, although on the basis of the performance of car #333 and its testing of noble metal catalysts, Chrysler seems closer in technological advancement to Ford than to General Motors. *See* Technical Appendix at 17.

[74] *Id.* at 44.

[75] The data on the efficiency of the Engelhard converter was from converters tested principally on Ford vehicles. *Id.* at 53.

[76] Supplement to Decision at 1.

production vehicles begins, any one of the three major companies cannot meet the 1975 standards, it is a likelihood that standards will be set to permit the higher level of emission control achievable by the laggard. This will be the case whether or not the leader has or has not achieved compliance with the 1975 standards. Even if the relaxation is later made industry-wide, the Government's action, in first imposing a standard not generally achievable and then relaxing it, is likely to be detrimental to the leader who has tooled up to meet a higher standard than will ultimately be required.

In some contexts high achievement bestows the advantage that rightly belongs to the leader, of high quality. In this context before us, however, the high achievement in emission control results, under systems presently available, in lessened car performance—an inverse correlation. The competitive disadvantage to the ecological leader presents a forbidding outcome—if the initial assumption of feasibility is not validated, and there is subsequent relaxation—for which we see no remedy.[79]

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manufacturers can meet the 1975 standards. Moreover, there is no evidence on the record to show that converters will perform equally well on different vehicles. This option may be effectively foreclosed as the lead time for production is approached, at which point the companies will be committed to their own individually developed systems.

[79] One could imagine some form of regulation through interim standards, whereby the laggard could be deprived of an expected windfall, through requiring some percentage of his vehicles to meet a standard which can only be met by the leader; but this form of economic regulation does not seem contemplated by Congress and would be subject to innumerable regulatory problems. Congressional indemnities might present a possibility. Obviously neither possibility could reasonably be taken into account as a basis for decision.

C. *Light Weight Trucks*

We now take up the serious contention of International Harvester (IH) that the EPA decision effectively rules out the production of 1975 model year IH light weight trucks and multi-purpose passenger vehicles (MPVs). This requires us to focus on the Administrator's conception that the 1970 Clean Air Act envisioned restricting production of vehicles to that necessary to fill "basic demand." [80]

The Administrator does not dispute International Harvester's claim that it will not be able to produce the vehicles in question, and indeed the limited testing of one of its MPVs showed, even as evaluated by EPA methodology, that such standards could not be achieved.[81] Yet a suspension was not granted, presumably for the reasons advanced by EPA to this court, that International Harvester was "required to alter the performance characteristics of its vehicles in the interest of meeting the 1975 emission standards." [82] The inability of IH vehicles to meet the standards seems accountable by the uses to which they are put, hauling large loads or towing heavy trailers. To serve this purpose vehicles must be designed with higher than normal axle ratios, thus requiring greater power from the engine and producing higher exhaust gas temperatures in order to attain any given speed.[83] Therefore, for all practical purposes a redesign of performance

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[80] Decision at 9-10.

[81] *See* Technical Appendix at 58-60.

[82] (1) Brief of Respondent at 37. (Respondents submitted two briefs to this court, one responsive only to the petition of International Harvester in case No. 72-1517, the other responsive to all four petitioners. For reference the former is denoted as (1), the latter as (2).

[83] Brief of IH at 24-25. *Also see* Transcript at 1167 et seq.

characteristics will preclude the present uses to which IH vehicles are put.

The Administrator, nonetheless, takes the position that International Harvester can be denied a suspension because he has found that "new car demand" will be satisfied by the production of the major auto companies, and thus apparently posits that the absence from the 1975 market of all light weight trucks and MPVs is fully consistent with the Act. We cannot agree.

Section 202(b)(1) of the Act applies its drastic standards to 1975 models of "light duty vehicles." It is our view that the legislative history reveals this term to mean "passenger cars." In the Report of the Senate Committee on Public Works on S.4358,[84] the Committee clearly distinguished between the automobile, which must "meet a rigid timetable and a high degree of emission control compliance," and other vehicles, such as "trucks and buses and other commercial vehicles," which are governed by a different authority to promulgate standards. At another point of the Senate Report, the legislative use of the term light duty vehicles, as interchangeable with passenger cars, is made even more clear: [85]

> The authority provided in section 202(a) would continue to be available to the [Administrator] to establish standards for light duty motor vehicles (passenger cars) during the period prior to and following the effective date of the standards established by subsection (b).

References abound in Congressional debate to the same effect.[86] This kind of legislative intent must be given

[84] S. Rep. No. 91-1196, 91st Cong., 2d Sess. 23 (1970).

[85] *Id.* at 24.

[86] *See, e.g.*, 116 Cong. Rec. 42,383 (Senator Muskie); 116 Cong. Rec. 32,921-22 (Senator Baker) (standards envisioned to be for automobiles).

priority, in interpreting this law, over any presumption of continuance of prior administrative definitions of this term[87] or to the policy of upholding reasonable interpretations of statutes by administrative agencies[88] in the absence of other discernible legislative intent. Volkswagenwerk v. FMC, 390 U.S. 261, 272 (1967); Greater Boston Television Corp. v. FCC (I), 143 U.S.App.D.C. 383, 392, 444 F.2d 841, 850, *cert. denied,* 403 U.S. 923 (1971).

For the above reasons we cannot sustain the definition of "Light duty vehicle" as:[89]

> any motor vehicle either designed primarily for transportation of property and rated at 6,000 pounds GVW or less or designed primarily for transportation of persons and having a capacity of 12 persons or less

to the extent that it includes light weight trucks in the category that must meet the drastic emission reduction standards set for 1975 models. These light weight trucks will be governed by the standards duly promulgated by EPA for "trucks and buses and other commercial vehicles."

This is not to say that the modification of the "light duty vehicles" definition must exclude MPVs, which

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[87] EPA points out that prior regulation under the Clean Air Act in June 1968 had defined light duty vehicles as motor vehicles "designed for transportation of persons or property on a street or highway and weighing 6,000 pounds GVW or less" 33 Fed. Reg. 8305 (1968), but this cannot be conclusive, given the legislative intent to the contrary. Moreover, the prior regulation did not have the effect of eliminating IH vehicles from the market because the emission standards were within the reach of heavier vehicles at that time.

[88] The policies behind the decision in Udall v. Tallman, 380 U.S. 1 (1965) are thus inapplicable.

[89] 36 Fed. Reg. 22,448 (1971).

largely overlap in their usage with passenger cars. We merely hold the present regulation contrary to legislative intent. We have jurisdiction to decide this issue, even though the reasonableness of the regulation could be challenged in a separate proceeding in the District Court,[90] because the validity of the regulation is a premise of the refusal to grant suspension. "It would be an empty and useless thing to review an order . . . based on a regulation the validity of which might be subsequently nullified." Doe v. Civil Aeronautics Board, 356 F.2d 699, 701 (10th Cir. 1966).

We decline the proposal of International Harvester, therefore, that only its vehicles be granted a suspension. Light weight trucks of other manufacturers, such as Ford, equally demonstrated an inability to comply with the 1975 standards.[91] Under the view taken here, the light weight trucks of all manufacturers are properly exempted from the scope of "light duty vehicles." This comports with competitive as well as statutory considerations, as the Administrator's own brief delineates:[92]

> If International Harvester is granted a suspension, it should be able to sell its vehicles at a lower cost than competitors who met the standards. This is so because International Harvester's 1975 models would not include expensive catalytic devices to control emissions. Also the Company's vehicles would probably perform better for the same reason. Thus, if suspension is granted, it is likely that International Harvester will gain a substantial competitive advantage over manufacturers who sacrificed the performance

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[90] *See* 42 U.S.C. § 1857h-5(b)(1).

[91] *See e.g.,* Technical Appendix at 33-43 where no predictions as to conformity were made for any Ford trucks.

[92] (1) Brief of Respondent at 44.

of their vehicles, and perhaps profits, in order to comply with the 1975 standards.

Assuming light duty vehicles are defined by EPA to include MPVs a question may arise whether they are entitled to a one-year suspension, for lack of feasibility, even though passenger vehicles generally should be denied a suspension. We shall not consider this question unless and until EPA has had an opportunity to address itself to the problems in the light of our opinion herein.

D. *The Issue of Feasibility Sufficient for Basic Auto Demand*

The foregoing conclusion is not to be misunderstood as amounting to an acceptance of another "basic demand" contention raised by the auto manufacturers. We are inclined to agree with the Administrator that as long as feasible technology permits the demand for new passenger automobiles to be generally met, the basic requirements of the Act would be satisfied, even though this might occasion fewer models and a more limited choice of engine types. The driving preferences of hot rodders are not to outweigh the goal of a clean environment.

A difficult problem is posed by the companies' contention that the production and major retooling capacity does not exist to shift production from a large number of previous models and engine types to those capable of complying with the 1975 standards and meeting the demand for new cars. The Administrator made no finding as to this problem. We believe the statute requires such a finding, explaining how the Administrator estimates "basic demand" and how his definition conforms to the statutory objective. The emission standards set for 1976 cannot be breached, since they represent an absolute judgment of Congress. But as to the decision on a one-year suspension, and the underlying issue of technological feasibility, Congress intended, we think, that the Administrator should take into account such "demand" considerations.

A significant decrease in auto production will have a major economic impact on labor and suppliers to the companies. We have no reason to believe that effective technology did not comport within its meaning sufficient technology to meet a basic level of consumer demand.

E. *Balancing of Risks*

This case inevitably presents, to the court as to the Administrator, the need for a perspective on the suspension that is informed by an analysis which balances the costs of a "wrong decision" on feasibility against the gains of a correct one. These costs include the risks of grave maladjustments for the technological leader from the eleventh-hour grant of a suspension, and the impact on jobs and the economy from a decision which is only partially accurate, allowing companies to produce cars but at a significantly reduced level of output. Against this must be weighed the environmental savings from denial of suspension. The record indicates that these will be relatively modest. There is also the possibility that failure to grant a suspension may be counter-productive to the environment, if there is significant decline in performance characteristics.

Another consideration is present, that the real cost to granting a suspension arises from the symbolic compromise with the goal of a clean environment. We emphasize that our view of a one year suspension, and the intent of Congress as to a one year suspension, is in no sense to be taken as any support for further suspensions. This would plainly be contrary to the intent of Congress to set an absolute standard in 1976. On the contrary, we view the imperative of the Congressional requirement as to the significant improvement that must be wrought no later than 1976, as interrelated with the provision for one-year suspension.

The flexibility in the statute provided by the availability of a one-year suspension only strengthens the impact of the absolute standard. Considerations of fairness will support comprehensive and firm, even drastic, regulations, provided a "safety valve" is also provided—ordinarily a provision for waiver, exception or adjustment, in this case a provision for suspension.[93] "The limited safety valve permits a more rigorous adherence to an effective regulation." WAIT Radio v. FCC, *supra*, 135 U.S.App.D.C. at 323, 418 F.2d at 1159. To hold the safety valve too rigidly is to interfere with the relief that was contemplated as an integral part of the firmness of the overall, enduring program.

We approach the question of the burden of proof on the auto companies with the previous considerations before us.

IV. THE REQUIRED SHOWING ON "AVAILABLE TECHNOLOGY"

It is with utmost diffidence that we approach our assignment to review the Administrator's decision on "available technology." The legal issues are intermeshed with technical matters, and as yet judges have no scientific aides. Our diffidence is rooted in the underlying technical complexities, and remains even when we take into account that ours is a judicial review, and not a technical or policy redetermination, our review is channeled by a salutary restraint, and deference to the expertise of an agency that provides reasoned analysis. Nevertheless we must proceed to the task of judicial review assigned by Congress.

The Act makes suspension dependent on the Administrator's determination that:

> the applicant has established that effective control

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[93] Permian Basin Area Rate Cases, 390 U.S. 747, 781 (1968); WAIT Radio v. FCC, 135 U.S.App.D.C. 317, 321, 418 F.2d 1153, 1157 (1969) and cases cited.

> technology, processes, operating methods, or other alternatives are not available or have not been available for a sufficient period of time to achieve compliance prior to the effective data of such standards . . . .

A. *Requirement of Observed Data From Manufacturers*

Clearly this requires that the applicants come forward with data which showed that they could not comply with the contemplated standards. The normal rules place such a burden on the party in control of the relevant information.[94] It was the auto companies who were in possession of the data about emission performance of their cars.

The submission of the auto companies unquestionably showed that no car had actually been driven 50,000 miles and achieved conformity of emissions to the 1975 standards. The Administrator's position is that on the basis of the methodology outlined, he can predict that the auto companies can meet the standards, and that the ability to make a prediction saying the companies can comply means that the petitioners have failed to sustain their burden of proof that they cannot comply.

B. *Requisite Reliability of Methodology Relied on by EPA To Predict Feasibility Notwithstanding Lack of Actual Experience*

We agree with the Administrator's proposition in general. Its validity as applied to this case rests on the reliability of his prediction, and the nature of his assumptions. One must distinguish between prediction and prophecy. *See* EDF v. Ruckelshaus, 142 U.S.App.D.C. 74, 89, 439 F.2d 584, 597 (1971). In a matter of this importance, the predictor must make a showing of reliability of the methodology of prediction, when that is being relied on to

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[94] IX Wigmore, On Evidence § 2486 (3d ed. 1940).

overcome this "adverse" actual test data of the auto companies. The statute does not contemplate use of a "crystal ball." *See* National Resources Defense Council, Inc. v. Morton, 148 U.S.App.D.C. 5, 15 458 F.2d 827, 837 (1972).

The Administrator, however, raises a different issue by contending that the companies, wholly aside from his methodology, did not submit sufficient evidence to enable him to make the required determination as to "available technology." This goes to the standard rather than the burden of proof, and comes close to adoption of "beyond a reasonable doubt" as the required showing. Aside from a possible finding of bad faith, which the Administrator specifically eschews making, this position cannot stand. The companies came forward with all the data that there was to be had, and the Administrator did not specifically ask for more. Additionally, our perspective on the interests furthered by a sound EPA decision, and jeopardized by a "wrong decision," are material to the issue of standard of proof. This is a situation where, as we have stated, the risks of an erroneous denial of suspension outweigh the risks of an erroneous grant. On the issue of burden of proof, the standard adopted must take into account the nature and consequences of risk of error. *See* In re Winship, 397 U.S. 358, 371-72 (1970) (Mr. Justice Harlan, concurring); U.S. v. Brown, Slip Opinion No. 24,646 (D.C. Cir., January 8, 1973). This view of the standard of proof dictates the standard normally adopted in civil matters, a preponderance of the evidence.[95]

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[95] The fact that a preponderance of evidence standard was originally in Senate Bill 4358, but deleted in Conference, offers no basis for an opposite conclusion. No affirmative indication exists that Congress wanted a higher standard and the Conference delegation may simply have been intended to eliminate a requirement which is mere surplussage in the civil litigation context. *See* S.4358, 91st Cong., 2d Sess., printed in S.Rep. No. 91-1196, 91st Cong., 2d Sess. 103 (1970), § 202

Our approach relates considerations of ecological and economic costs, dealt with above, to the legal issue of burden and standard of proof. Nominally the statute, in § 202(b)(5)(D), sets forth separate criteria as to "public interest," in clause (i), and "available technology," in clause (iii). But the assignment of the burden and standard of proof on "available technology" inescapably involves many of the same considerations as those involved in a "public interest" determination, and it would have been helpful to this court if the Administrator had expressly commented on the public interest in this connection.

The underlying issue is the reasonableness and reliability of the Administrator's methodology, for it alone offsets the data adduced by petitioners in support of suspension. It is the Administrator who must bear the burden on this matter, because the development and use of the methodology are attributable to his knowledge and expertise. When certain material "lies particularly within the knowledge" of a party he is ordinarily assigned the burden of adducing the pertinent information.[96] This assignment of burden to a party is fully appropriate when the other party is confronted with the often-formidable task of establishing a "negative averment." United States v. Denver & R.G.R. Co., 191 U.S. 84, 92 (1903). In the context of this proceeding, this requires that EPA bear a burden of adducing a reasoned presentation supporting the reliability of its methodology.

C. *Analysis of EPA Assumptions*

The multiple assumptions used by the Administrator in making his prediction are subject to serious doubts.

(b) (4) (C) (iii). *See also* Conference Report, H.R. Rep. No. 91-1783, 91st Cong., 2d Sess. 48-49 (1970).

[96] Compare Commonwealth of Puerto Rico v. FMC, —— U.S.App.D.C. ——, 468 F.2d 872 (1972).

The basic formula used to make the prediction that each of the manufacturers could meet the 1975 standards was based on 1975 certification requirements, so that in part it paralleled testing procedures which would be used in 1975 to certify automobiles for sale. The formula is:[97]

$$\begin{matrix}\text{50,000 mile} \\ \text{emissions}\end{matrix} = \begin{matrix}\text{4000 mile} \\ \text{emissions}\end{matrix} \times \begin{matrix}\text{deterioration} \\ \text{factor}\end{matrix}$$

Four kinds of assumptions were used in making the 50,000 mile emission prediction: (1) regulatory, (2) engineering or scientific, (3) techniques of application of basic formula to particular companies, and (4) statistical reliability of the final prediction.

1. *Regulatory assumptions*

First, EPA assumed that certain types of maintenance would have to be performed on 1975 model year cars, if its 50,000 miles emission predictions were to be meaningful. Subsequent to the issue of its Technical Appendix, a Proposed Rule Making formulated these requirements as part of 1975 certification procedure.[98] This assumption was necessary because much of the data supplied by the companies was obtained from cars that were under rigid controls during testing.[99] The problem with such maintenance assumptions is whether the ordinary driver will actually pay for this kind of maintenance just to reduce the emission levels of his automobile. It is one thing to build maintenance into the 1975 certification procedure, when fleet samples are durability tested. It is another to posit that such standards will be maintained, or are rea-

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[97] Technical Appendix at 3.

[98] *See* note 26 *supra*.

[99] Car #333, used as the basis for the Chrysler prediction, is the outstanding example. *See* Transcript at 2095-2107; JA 1331, Doc. 143.

sonably likely to be maintained, by consumers. A hard question is raised by the use of a methodological assumption without evidence that it will correspond to reality, or a reasonable and forthright prediction based on expertise.

Secondly, the predicted emission level assumes that there will be one total replacement of the catalytic converter at some time after 25,000 miles. This entered into the formula as an adjustment to the predicted deterioration factor.[100] The critical question is how much will the one replacement reduce emissions otherwise obtainable by use of a single catalyst. This relationship had to be assumed because manufacturers had not used catalytic converter replacements in their testing. The Administrator admitted that this factor was imprecise.[101] Yet, in the case of General Motors, the use of the assumed value of this factor was critical in allowing the Administrator to make a 50,000 mile emission prediction under the 1975 standards.[102]

The third regulatory assumption relates to the average lead level which will exist in gasoline available for 1975 model year cars. Lead levels in gasoline contribute to the levels of HC and CO both in terms of normal emission control achievable (the 4000 mile emission) and to the deterioration in emissions over time (deterioration factor). Thus, in the case of the Chrysler car used to predict conformity with the 1975 standards, a .03 lead in gasoline produced 4000 mile emissions of .27 grams HC and 1.51 CO, whereas a .05 level of lead resulted in .29 and 1.66 grams respectively. Similarly .03 lead produced a corrected

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[100] Technical Appendix at 10.

[101] This statement was made in the context of the application of this assumption to predicting the conformity of General Motors with prescribed standards. Technical Appendix at 47.

[102] *Id.* at 51.

deterioration factor of .67 HC and 1.5 CO, whereas a .05 level produced .73 HC and 1.65 CO.[103]

On December 27, 1972, a regulation was promulgated "designed to assure general availability by July 1, 1974, of suitable gasolines containing no more than .05 grams per gallon of lead. . ."[104] It was the assumption of the Administrator that the .05 maximum would result in gas containing on the average .03 grams per gallon of lead. The discrepancy between the maximum and average is accounted for by the contamination of lead free gasoline from its point of production to its marketing outlet. Thus EPA will allow a maximum of .05 but anticipates that on the average fuel will be at .03. This assumption is, however, subject to testimony in the record indicating a difference between companies in their ability to achieve gasoline with a low lead level complying with the proposed regulation. Amoco said that its proposal for a .07 maximum "should result in effective lead levels of .02 to .03 grams of lead per gallon."[105] Texaco did not think it could deliver gas to service stations at a lead level below .07.[106] We cannot resolve whether a differential ability really exists, but we also have no refinement and resolution by the EPA (as distinguished from the briefs of its counsel). We do not say this matter is a critical defect; still it leaves a residue of uncertainty that beclouds the EPA assumption of a .03 average, needed in its methodology to predict conformity with the 1975 standards.

2. *Engineering and scientific assumptions*

Engineering or scientific assumptions are made in pre-

[103] *Id.* at 22.

[104] Supplement to Decision at 2.

[105] Letter, B.J. Yarrington, Amoco, to EPA, May 9, 1972, at 2, JA at 1539.

[106] JA at 1704-05.

dicting 4000 mile emissions and deterioration factors, and we shall give separate consideration to each independent variable.

a. *The 4000 mile emission factor*

The use of 4000 mile emissions as a starting point is based on certification procedures.[107] No challenge has been made to this mileage as a base point, largely because it appears that at this mileage the engine is broken in and emission levels are relatively stabilized.[108] EPA decided to adjust raw data supplied, at least in the case of Ford and Chrysler, of emissions at 4000 miles to take account of a "Lead Adjustment Factor."[109] This was done because in most cases emissions data reflected fuels with a close to zero lead level which had been used by the manufacturers in their testing programs.

Lead adjustment factor

This Lead Adjustment Factor was calculated using only Ford cars, but the value of the factor was assumed to be the same in adjusting Chrysler 4000 mile emissions with this factor.[110] The cars had been tested with a dynamometer, a type of test equipment used for laboratory testing of an engine. A measurement of the efficiency of the catalytic converter at the 4000 mile mark was the critical value which had to be obtained from the dynamometer since this would indicate what the proper lead adjustment factor would be.[111]

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[107] See note 24 *supra.*

[108] Joint Supplement to Briefs of Petitioners General Motors, Corporation, Chrysler Corporation and Ford Motor Company at 8.

[109] Technical Appendix at 22 (Chrysler); at 36 (Ford).

[110] *Id.* at 6.

[111] The parties are apparently agreed that it would be to

EPA assumed that 200 hours on the dynamometer corresponded to 4000 miles usage, based on a critical and contested EPA assumption that the tests were conducted at 1000 RPM. Petitioners claim that the high temperature readings on the dynamometer reflect a higher RPM, and hence that a testing below 200 hours corresponded to 4000 miles of use. EPA disputes the steps in that chain of reasoning, and argues that a higher temperature may be attributable not to a RPM in excess of 1000, but to a heavy load on the vehicle, and in the alternative contends that even if there was a RPM greater than 1000, the speed may not have increased, due to a shift in gear.

The cause of higher than expected temperature readings cannot be ascertained from the record, and we are left with the alternative contentions of the parties. It is up to EPA, however, to suppoit its methodology as reliable, and this requires more than reliance on the unknown, either by speculation, or mere shifting back of the burden of proof.[112]

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on the dynamometer to represent 4000 mile emissions, presumably on the assumption that this will mean that emissions the advantage of the companies to take fewer hours than 200 would be higher. This is not readily apparent to the court, given its limited understanding, from the graphs or equations provided in the Technical Appendix, at 5-6, 11-12, 18, 34. If this were a critical issue it might be necessary to arrange further submission on this point, but since it relates to one of many problems with EPA methodology we do not deem it necessary. A lacuna in judicial understanding is to some extent inescapable in matters of such technical difficulty, and here it does not seem critical for the court to refine this particular problem.

[112] A scientific paper was cited by petitioners to establish that RPM was in fact 1750, JA 1616. Apparently this was not in the record made before EPA. In any event, we do not discern how this paper supports the claim made, though we are aware that this statement may merely reflect the court's lack of scientific understanding.

b. *Deterioration factor*

Methodological problems also existed with the calculation of the deterioration factor, which took account of possible deterioration in emission quality from 4000 miles to 50,000 miles. Different questions arose as to the calculation of this factor for Ford and Chrysler.

In the case of Ford, the Administrator predicted that emissions would *improve* from 4000 to ~~5000~~ 50,000 miles, and arrived at a deterioration factor of less than 1.[113] He calculated average deterioration factors for Ford vehicles of .80 HC and .83 CO. This is to be compared with a deterioration factor of 2.5 used by NAS.[114] The Administrator never explained why there should be no deterioration. Nor does EPA explain how this result can be squared with other data on Ford catalyst efficiencies, which was used in the case of the General Motors prediction, showing 50,000 mile catalyst efficiencies ranging from 21% to 53% for HC and 47% to 72% for CO.[115]

In the case of Chrysler, the deterioration factor was also calculated to be less than 1, but this figure was only arrived at after eliminating some data points from the emission measurement on the tested car #333, due to what EPA claimed were unrepresentative points resulting from non-catalyst malfunctions.[116] Although it may be, as EPA argues here, that including the data points would still produce predicted 50,000 emission levels in conformity with the 1975 standard, the fact remains that these data points were removed. Moreover, it is not apparent why one should ignore malfunctions of a car which contribute to high emissions, even if they are not malfunctions of the

[113] Technical Appendix at 34.

[114] Interim Standards Report at 8.

[115] JA at 957, Doc. 135.

[116] Technical Appendix at 17.

converter. Malfunctions of cars occur to some degree, and cars operating in 1975 will undobutedly be subject to them.

Lead adjustment factor

A lead adjustment factor is applied to the deterioration factor, as well as to 4000 mile emissions. EPA estimated on the basis of the questionable Ford dynamometer data, that lead levels had no observable effect, which was contrary to industry testimony on the subject.[117] The Administrator evidently had doubts as to the dependability of these results as well, and therefore assumed a 10% factor for lead adjustment.[118] No explanation is given of the origins of this 10% figure. If the willingness to take some factor evidences distrust in the data, the question then becomes whether 10% is enough.

3. *EPA methodology for General Motors*

In the case of General Motors an entirely different methodology from that used for Ford and Chrysler was employed. This was adopted due to limited testing by GM of noble metal catalysts.

The methodology was to take the raw emission values produced by a GM car prior to catalyst treatment of any kind multiplied by a factor representing the efficiency of the catalyst, *i.e.*, the percentage of a given pollutant that the catalyst converts to harmless vapor, in order to obtain the projected overall emission performance at 50,000 miles.[119] These methods of calculation were developed by the Administrator and were not used by NAS in their

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[117] EPA merely responds to the testimony by stating that it was unaccompanied by data, but offers no expert opinion which indicates that such a relationship does not exist. (2) Brief of Respondent, App. A and B at 24, n.35.

[118] Technical Appendix at 7.

[119] *Id.* at 3, 44-55.

evaluation.[120] The catalyst efficiency data were taken from Engelhard converters used principally on Ford cars and applied against the raw emissions of a General Motors engine. This assumed, with no explanation of the validity of such an assumption, that Engelhard catalysts will function as efficiently in General Motors cars as in those of Ford. A prediction was made on the basis of a hypothetical case. One cannot help be troubled by the adoption of this technique for General Motors. It was apparently recognized as at best a second best approach, in terms of the reliability of the prediction, or the same catalyst efficiency procedure would also have been used for Ford and Chrysler.

4. *Statistical reliability of assumptions*

In this case the Administrator is necessarily making a prediction. No tests exist on whether this prediction is or is not reliable. It would, therefore, seem incumbent on the Administrator to estimate the possible degree of error in his prediction. The NAS, for example, said that the data of the manufacturers were subject to ± 20-30% margin of error,[121] and this is separate from any margin of error that may be due to the various assumptions made by the Administrator. It is not decisive to say, as EPA argues in its brief, that this is just a matter of quality control in production. The first issue is whether the automobile built with rigid adherence to specifications will perform as predicted. The issue of quality control, whether cars will indeed be built in accordance with specifications, raises a separate and additional problem.

The possibility of error must take into account that only

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[120] No mention of this possible methodology is mentioned in the NAS Interim Report, and the Administrator admits this in Supplement to Decision at 1. *See* text at note 76.

[121] Interim Standards Report at 7.

1 Ford car, 1 Chrysler car, and 1 hypothetical General Motors car form the foundation for predicted conformity with the 1975 standard.[122] The Administrator would say that it is enough to validate the principle of the electric light bulb if only one is seen at work. But we do not yet have one that has worked; instead we have four predictions. Questions like these arise: (1) For how many different types of engines will these predictions be valid? (2) Does it make a difference that the tested cars were experimental and driven under the most controlled conditions? The best car analysis of EPA raises even further doubts when considered alongside the NAS Report which used 55 vehicles in arriving at its recommended interim standard.[123]

V. CONCLUSION AND DISPOSITION

We may sensibly begin our conclusion with a statement of diffidence.[124] It is not without diffidence that a court undertakes to probe even partly into technical matters of the complexity of those covered in this opinion. It is with even more diffidence that a court concludes that the law, as judicially construed, requires a different approach from that taken by an official or agency with technical expertise. Yet this is an inescapable aspect of the judicial condition, though we stay mindful of the overarching consideration

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[122] Technical Appendix at 41 (Ford 351 C); at 22 (Chrysler car 333); at 51 (General Motors engine 455/full size).

[123] Interim Standards Report at 8. EPA, moreover, offers no explanation as to whether there were "best system" cars besides those included in the Appendix which did not meet the standards, and why one should not be concerned about the fact that the "best system" cars which are in the Technical Appendix, other than those cited in note 103, *supra*, do not meet the standard.

[124] Compare Blair v. Freeman, 128 U.S.App.D.C. 207, 210, 370 F.2d 229, 232 (1966).

that a court's role on judicial review embraces that of a constructive cooperation with the agency involved in furtherance of the public interest.[125]

> A court does not depart from its proper function when it undertakes a study of the record, hopefully perceptive, even as to the evidence on technical and specialized matters, for this enables the court to penetrate to the underlying decisions of the agency, to satisfy itself that the agency has exercised a reasoned discretion, with reasons that do not deviate from or ignore the ascertainable legislative intent.[126]

In this case technical issues permeate the "available technology" determination which the Administrator made the focal point of his decision. In approaching our judicial task we conclude that the requirement of a "reasoned decision" by the Environmental Protection Agency means, in present context, a reasoned presentation of the reliability of a prediction and methodology that is relied upon to overcome a conclusion. of lack of available technology, supported prima faciely by the only actual and observed data available, the manufacturers' testing.

The number of unexplained assumptions used by the Administrator, the variance in methodology from that of the Report of the National Academy of Science, and the absence of an indication of the statistical reliability of the prediction, combine to generate grave doubts as to whether technology is available to meet the 1975 statutory standards. We say this, incidentally, without implying or intending any acceptance of petitioners' substitute assumptions. These grave doubts have a legal consequence. This is customarily couched, by legal convention, in terms of

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[125] Morgan v. United States, 304 U.S. 1 (1938); Greater Boston TV v. FCC (I), *supra*.

[126] Greater Boston TV v. FCC, *supra*, 143 U.S.App.D.C. at 392; 444 F.2d at 850.

"burden of proof." We visualize the problem in less structured terms although the underlying considerations, relating to risk of error, are related. As we see it the issue must be viewed as one of legislative intent. And since there is neither express wording or legislative history on the precise issue, the intent must be imputed. The court must seek to discern and reconstruct what the legislature that enacted the statute would have contemplated for the court's action if it could have been able to foresee the precise situation.[127] It is in this perspective that we have not flinched from our discussion of the economic and ecological risks inherent in a "wrong decision" by the Administrator. We think the vehicle manufacturers established by a preponderance of the evidence, in the record before us, that technology was not available, within the meaning of the Act, when they adduced the tests on actual vehicles; that the Administrator's reliance on technological methodology to offset the actual tests raised serious doubts and failed to meet the burden of proof which in our view was properly assignable to him, in the light of accepted legal doctrine and the intent of Congress discerned, in part, by taking into account that the risk of an "erroneous" denial of suspension outweighed the risk of an "erroneous" grant of suspension. We do not use the burden of proof in the conventional sense of civil trials, but the Administrator must sustain the burden of adducing a reasoned presentation supporting the reliability of EPA's methodology.

EPA's diligence in this proceeding, fraught with questions of statutory interpretation, technical difficulties and burdensome time constraints placed on the decision-making process, has been commendable. The agency was presented with a prickly task, but has acted expeditiously to

[127] Montana Power Co. v. FPC, 144 U.S.App.D.C. 263, 270, 445 F.2d 739, 746 (en banc, 1970), *cert. denied* 400 U.S. 1013 (1971).

carry out what it perceived to be a drastic mandate from Congress. This statute was, indeed, deliberately designed as "shock treatment" to the industry. Our central difference with the Administrator, simply put, stems from our view concerning the Congressional intent underlying the one year suspension provision. That was a purposeful cushion—with the twin purpose of providing "escape hatch" relief for 1975, and thus establishing a context supportive of the rigor and firmness of the basic standards slated for no later than 1976. In our view the overall legislative firmness does not necessarily require a "hard-nosed" approach to the application for suspension, as the Administrator apparently supposed, and may indeed be furthered by our more moderate view of the suspension issue, particularly in assigning to the Administrator the burden of producing a reasoned presentation of the reliability of his methodology. This is not a matter of clemency, but rather a benign approach that moderates the "shock treatment" so as to obviate excessive and unnecessary risk of harm.

Our decision is also responsive to the differences between the EPA decision and the NAS Report. Although in some instances "the factual findings and technical conclusions" [128] are consistent with those of the Administrator, the NAS conclusion was that technology was not available to meet the standards in 1975. Congress called on NAS, with presumed reliance on the knowledge and objectivity of that prestigious body, to make an independent judgment. The statute makes the NAS conclusion a necessary but not sufficient condition of suspension. While in consideration of the other conditions of suspension, EPA was not necessarily bound by NAS's approach, particularly as to matters interlaced with policy and legal

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[128] Supplement to Decision at 1.

aspects, we do not think that it was contemplated that EPA could alter the conclusion of NAS by revising the NAS assumptions, or injecting new ones, unless it states its reasons for finding reliability—possibly by challenging the NAS approach in terms of later-acquired research and experience.

These factors combine to convince us that, under our view of Congressional intent, we cannot affirm the EPA's denial of suspension as stated. That is not necessarily to assume, as at least some petitioners do, that the EPA's process must be brought to nullity.

The procedures followed in this case, whether or not based on rulings that were "mistaken" when made, have resulted in a record that leaves this court uncertain, at a minimum, whether the essentials of the intention of Congress were achieved. This requires a remand whereby the record as made will be supplemented by further proceedings. In the interest of justice, see 28 U.S.C. § 2106, and mutual regard for Congressional objective, the parties should have opportunity on remand to address themselves to matters not previously put before them by EPA for comment, including material contained in the Technical Appendix filed by EPA in 1972 subsequent to its Decision.

It is contemplated that, in the interest of providing a reasoned decision, the remand proceeding will involve some opportunity for cross-examination. In the remand proceeding—not governed by the same time congestion as the initial Decision process—we require reasonable cross-examination as to new lines of testimony, and as to submissions previously made to EPA in the hearing on a proffer that critical questions could not be satisfactorily pursued by procedures previously in effect. There is, however, still need for expedition, both by virtue of our order and the "lead time" problem, and the EPA may properly confine cross-examination to the essentials, avoiding discursive or repetitive questioning.

Following our suggestion in Environmental Defense Fund, Inc. v. EPA, Slip Opinion No. 71-1365 (D.C. Cir. May 5, 1972), the Administrator may consider possible use of interim standards short of complete suspension. The statute permits conditioning of suspension on the adoption, by virtue of the information adduced in the suspension proceeding, of interim standards, higher than those set for 1974.[129]

We cannot grant petitioners' request that this court order a suspension since determinations which Congress made necessary conditions of suspension, as to the public interest and good faith, have not been made by the Administrator. The Administrator's decision did not reach these questions and accordingly we must remand for further consideration. The initial requirement that an EPA decision on the suspension, aye or nay, be made within 60 days of the application, obviously does not preclude further consideration following remand by the court. In the interest of justice, 28 U.S.C. § 2106, and the Congressional intention that decisions be made timely in the light of considerations of "lead time" for 1975 model year production, we require the suspension deliberations by EPA to be completed within 60 days. The Administrator's decision on remand must, of course, be consistent with our legal rulings herein—including the need for re-

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[129] Thus, Section 202(b)(5)(A), 42 U.S.C. § 1857f-1(b)(5)(A), provides, in part:

> If he determines, in accordance with the provisions of this subsection, that such suspension should be granted, he shall *simultaneously* with such determination prescribe by regulation interim emission standards. . . . (Emphasis added.)

definition of light duty vehicles, and promulgation of an appropriate regulation.

In conformance to the Congressional contemplation of expedition, and our responsibilities as an appellate court, we further require that the Administrator render a decision, on the basis of the best information available, which extends to all the determinations which the statute requires as a condition of suspension.[130] We do not preclude further consideration of the question of "available technology,"

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[130] This obviates the possibility of delay if, for example, on remand the Administrator denied the suspension on the basis of only one of the four statutory findings, and this court subsequently reversed.

Since our disposition on remand requires a public interest determination, it disposes of the claim of petitioner Chrysler that the National Environmental Policy Act, 42 U.S.C. § 4321 et seq., requires that an impact statement be filed by the Administrator pursuant to a suspension decision.

The purpose of NEPA is to assure presentation to Congress and the public of the environmental impact of executive action. Here Congress has already decided that the environmental dangers require the statutory standards. The only executive decision is of a one year deferral, and the very stuff of such a decision, at least with a public interest determination, is to assess, *inter alia,* the environmental consequences of action and inaction. NEPA's objective will be fully served. As we stated in National Resources Defense Council, Inc. v. Morton, 148 U.S.App.D.C. 5, 15, 458 F.2d 827, 837 (1972), the requirements of NEPA should be subject to a "construction of reasonableness." Although we do not reach the question whether EPA is automatically and completely exempt from NEPA, we see little need in requiring a NEPA statement from an agency whose raison d'être is the protection of the environment and whose decision on suspension is necessarily infused with the environmental considerations so pertinent to Congress in designing the statutory framework. To require a "statement," in addition to a decision setting forth the same considerations, would be a legalism carried to the extreme.

especially if developments in the art provide enlightenment. Last but not least, especially in view of Ford's submission and the NAS Report concerning interim standards, we reiterate that the EPA's determination may consist of a conditional suspension that results in higher standards than an outright grant of applications for suspension.

The case is remanded for further proceedings not inconsistent with this opinion.

BAZELON, *Chief Judge, (concurring in result)*: Socrates said that wisdom is the recognition of how much one does not know.[1] I may be wise if that is wisdom, because I recognize that I do not know enough about dynamometer extrapolations, deterioration factor adjustments, and the like to decide whether or not the government's approach to these matters was statistically valid. Therein lies my disagreement with the majority.

The court's opinion today centers on a substantive evaluation of the Administrator's assumptions and methodology. I do not have the technical know-how to agree or disagree with that evaluation—at least on the basis of the present record. My grounds for remanding the case rest upon the Administrator's failure to employ a reasonable decision-making process for so critical and complex a matter. At this time I cannot say to what extent I could undertake an evaluation of the Administrator's findings if they were based on an adequate decisional process.

I cannot believe that Congress intended this court to delve into the substance of the mechanical, statistical, and technological disputes in this case. Senator Cooper, the author of the judicial review provision, stated repeatedly

[1] Plato, Apology of Socrates, § 57B.

that this court's role would be to "determine the question of due process."[2] Thus the court's proper role is to see to it that the agency provides "a framework for principled decision-making."[3] Such a framework necessarily includes the right of interested parties to confront the agency's decision and the requirement that the agency set forth with clarity the grounds for its rejection of opposing views.

The majority's interpretation of the present statute and the administrative precedents would give us no right to establish these procedural guidelines. Their opinion maintains that the strict deadlines in the Clean Air Act preclude any right to challenge the Administrator until after the decision has been made. It indicates that, since this hearing was "rule-making" rather than "adjudicatory", cross-examination and confrontation are not required under traditional rules of administrative law.

I understand this viewpoint, but I do not share it. I do not think the authors of the Clean Air Act intended to put such strict limits on our review of the Administrator's decision-making process. Further, the interests at stake in this case are too important to be resolved on the basis of traditional administrative labels. We recognized two years ago that environmental litigation represents a "new era" in administrative law.[4] We are dealing here not with an

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[2] 116 Cong. Rec. 33,086 (1970) ; *cf.* 116 Cong. Rec. 33,080, 33,084 (1970). One Senator referred to the court's "factfinding function"; his remarks make it clear that he could not have been referring to the review function of courts of appeal. 116 Cong. Rec. 33,085 (1970) (Senator Baker).

[3] Environmental Defense Fund, Inc. v. Ruckelshaus, 142 U.S.App.D.C. 74, 88, 439 F.2d 584, 598 (1971).

[4] *Id.* 142 U.S. App. D.C. at 87, 439 F.2d at 597. To the same effect is Mr. Justice Blackmun's opinion in Sierra

airline's fares or a broadcaster's wattage, but with all humanity's interest in life, health, and a harmonious relationship with the elements of nature.

This "new era" does not mean that courts will dig deeper into the technical intricacies of an agency's decision. It means instead that courts will go further in requiring the agency to establish a decision-making process adequate to protect the interests of all "consumers" of the natural environment.[5] In some situations, traditional rules of "fairness"—designed only to guard the interests of the specific parties to an agency proceeding—will be inadequate to protect these broader interests. This is such a case. Whether or not traditional administrative rules require it, the critical character of this decision requires at the least a carefully limited right of cross-examination at the hearing and an opportunity to challenge the assumptions and methodology underlying the decision.

The majority's approach permits the parties to challenge the Administrator's methodology only through the vehicle of judicial review. I do not think this is an adequate substitute for confrontation prior to the decision. I reach this position not only out of concern for fairness to the parties (". . . for if a party first learns of noticed facts through the final report . . . the burden of upsetting a decision announced as final is a heavy one."[6]) but also out of awareness of the limits of our own competence for the task. The petitioners' challenges to the decision force the court to deal with technical intricacies that are beyond our ken.[7]

Club v. Morton, 405 U.S. 727, 755 (1972) (dissenting opinion).

[5] Environmental Defense Fund, Inc. v. Hardin, 138 U.S. App. D.C. 391, 395, 428 F.2d 1093, 1097 (1970).

[6] 2 Davis, ADMINISTRATIVE LAW TREATISE, § 15.14 (1958).

[7] *Cf.* this court's dictum, in *Constructores Civiles de Centro-*

These complex questions should be resolved in the crucible of debate through the clash of informed but opposing scientific and technological viewpoints.

It is true that courts occasionally find themselves in the thick of technological controversies—e.g., in patent cases. But those are different circumstances. We do not review patent disputes until they have been through a full panoply of procedures involving full rights of confrontation. Further, unlike our decision in a patent case, our decision on the Administrator's action here is sure to be tested by analysis and challenge in Congress, in the scientific community, and among the public.

My brethren and I are reaching for the same end—a "reasoned decision"—through different means. They would have us examine the substance of the decision before us. There are some areas of administrative law—involving issues of liberty and individual rights—where judges are on firm ground in undertaking a substantive review of agency action. But in cases of great technological complexity, the best way for courts to guard against unreasonable or erroneous administrative decisions is not for the judges themselves to scrutinize the technical merits of each decision. Rather, it is to establish a decision-making process which assures a reasoned decision that can be held up to the scrutiny of the scientific community and the public.[8] "[T]he best test of truth is the power of the thought to get itself accepted in the competition of the market."[9] If we were to

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Americana v. Hannah, that "These forebodingly fecund matters were wisely placed beyond the ken of the judiciary." 148 U.S. App. D.C. 159, 168, 459 F.2d 1183, 1192 (1972).

[8] *Cf.* Citizens' Association of Georgetown v. Zoning Commission, Nos. 72-2103, etc. (D.C. Cir. Feb. 6, 1973).

[9] Abrams v. United States, 250 U.S. 616, 630 (1919) (Holmes, J., dissenting).

require procedures in this case that open the Administrator's decision to challenge and force him to respond, we could rely on an informed "market" rather than on our own groping in the dark to test the validity of that decision.

Candor requires the admission that the process of confrontation and challenge might not be possible within the statutory decision period of 60 days. My response would be to permit an extension of the time limit—perhaps 30 days more. This would put less strain on the overall statutory scheme—and on the manufacturers' lead time—than the months that have been expended in litigation, and now a remand, over the decision. Congress did not intend for us to enforce this relatively minor time restriction so strictly as to do major damage to the statute as a whole.

My brethren argue that the 60-day time limit in the statute precluded any opportuniy for cross-examination or confrontation at the time of the original decision. But their opinion would apparently permit these procedural rights on the remand. This bit of judicial legerdemain confounds me. I can find nothing in the statute or common sense to support this distinction. If anything, the statute, with its obvious emphasis on reaching a final decision quickly, would dictate procedures at the original decision which were sufficient to produce a reasoned decision without the need for a remand.

Outside of the foregoing differences, I agree with much of the majority opinion. I would have preferred to make the "public interest" factor—the considerations set forth in Part III of that opinion—an independent ground for suspension. The court today deals with the public interest indirectly, through the device of burden of proof. I do not fully understand this approach, but I suspect it leads to essentially the same result I favor.

FUEL ECONOMY

AND

EMISSION CONTROL

UNITED STATES

ENVIRONMENTAL PROTECTION AGENCY

OFFICE OF AIR AND WATER PROGRAMS

MOBILE SOURCE POLLUTION CONTROL PROGRAM

November 1972

I. INTRODUCTION

This paper analyzes the effect on fuel economy of emission controls on automobiles. The analysis examines the various vehicle design factors, including emission control devices, which affect motor vehicle fuel economy and discusses the impact of the individual variables. Fuel penalties which may be associated with emission control systems are placed into the perspective of other fuel penalties which are currently, or may in the future, be experienced by the motoring public.

No attempt is made here to deal with the question of national petroleum consumption. However, this analysis provides a part of the necessary input for such a study.

II. DEFINITION OF "FUEL ECONOMY" 1/

There are many ways to report the fuel economy of automobiles. Miles per gallon (MPG) is the most commonly used and will be used in this analysis. All figures reported in this analysis are in terms of miles per gallon over the Federal Driving Cycle (see Section III. C.) While the single parameter, miles per gallon, is easily understood and a good measure of fuel economy, it must be qualified. Many factors influence fuel economy, and a knowledge of these factors is needed if valid comparisons of fuel economy figures are to be made.

III. FACTORS AFFECTING FUEL ECONOMY

The fuel economy of in-use light duty vehicles can range between 50 and 5 mpg. The major factors that influence fuel economy and account for this wide spread are discussed below.

A. The Design of the Automobile

The most important parameters associated with automobile design include vehicle weight, rolling resistance (including tire, driveline and aerodynamic drag) and axle ratio. Higher weight usually means poorer fuel economy because more work is required to move the vehicle. Higher rolling resistance usually means poorer fuel economy because more work is done deforming the tires and pushing the vehicle through the air. A higher (numerically) axle ratio usually means poorer fuel economy because the engine revolutions per mile are greater. For modern vehicle design, however, weight is the single most important parameter.

B. The Manner In Which The Vehicle Is Driven

This factor is both important and difficult, if not impossible, to quantify. In general, given identical vehicles, the driver who drives "harder" will get poorer fuel economy than the driver who drives less hard. Examples of "hard" driving are accelerating at or near the maximum capability of the vehicle, high cruise speeds, not driving smoothly, and racing the engine at idle. The magnitude of the effect due to the driver can be great, but there is no data on which to quantify this factor.

C. The Type Of Route Traveled

The best fuel economy achievable with automobiles is at constant speed cruise between 20 and 50 miles per hour in high gear. The exact optimum speed depends on the vehicle and engine type. However, no realistic driving is done at such a constant speed. Driving in heavy intracity traffic with many stops per mile, long idling periods, and low average speeds generally results in the poorest fuel economy. Driving on the highway at a constant speed usually results in better fuel economy. For this reason, many references to vehicle fuel economy also refer to the type of route traveled. Usually the distinction is made between city or "around town" type of route; and "highway" type routes.

All fuel economy figures reported in this analysis were measured using the Federal Driving Cycle - an urban driving route. This was done in part because it is the only cycle on which there is consistent data. However, the cycle is useful for this analysis because it is representative of a significant portion of vehicle operation, in particular the driving done in urban areas.

D. The Engine

The design of the engine, its calibration, state of tune and overall mechanical condition affect fuel economy. Important design factors include compression ratio, intake and exhaust system configuration, internal friction and carburetor design. The calibration of the engine, its spark advance curve, the flow curve for the carburetor and the operation of the choke can all affect fuel economy. The state of tune of the engine as well as the condition of the parts that are usually involved in a tune up are important. Finally, the mechanical condition of the engine, especially valves and piston rings, can also hurt fuel economy if it is poor.

Emission controls have affected both the design and calibration of engines. The design of the combustion chamber, the compression ratio, the spark advance curve and the carburetor calibrations have all been changed. In addition, other devices like air pumps and exhaust gas recirculation have been added as emission control devices. All of these changes can have an effect on engine efficiency and, in turn, fuel economy.

E. Power and Convenience Accessories

Many power and convenience accessories are used on modern automobiles, including air conditioning, automatic transmissions, power steering, power brakes, power seats and heated windows. Although all of the devices use energy which eventually results in fuel usage, the effect on fuel economy of all but two are negligible. The two important ones are air conditioning and automatic transmissions.

The use of air conditioning lowers fuel economy. The extent to which it degrades fuel economy depends on how often the device is used, and how much cooling load is required of it.

An automatic transmission is not as efficient as a manual transmission. However, whether a vehicle equipped with an automatic transmission shows better or worse fuel economy than a comparable manual transmission vehicle depends on the way in which each vehicle is driven. All other things being equal, the manual transmission equipped vehicle will generally show better fuel economy.

F. Ambient Conditions

The ambient temperature, humidity, pressure (altitude), and wind speed and direction all affect fuel economy. However, except in the case of large variations from standard conditions (e.g. cruising into a strong headwind or operating at a very high altitude,) the fuel economy effects of ambient conditions are minor.

IV. EMISSION CONTROL EFFECTS ON FUEL ECONOMY

There are, theoretically, two different ways to assess the effects of emission control devices on fuel economy. One way is to determine the effect of any one modification (e.g. retarded spark) on fuel economy. This could be expressed as a percentage loss or gain, and the total effect on a vehicle employing many modifications might be derived from adding up all the individual device effects. This approach is not correct because the effects are not, in general, additive. When one control approach or device is used in combination with other devices as part of a total system, there are various synergistic effects which can either lessen or worsen the impact on fuel economy of any one device.

The other approach, which is employed in this analysis, is to use actual vehicle test data and from this data determine the effect of the complete emission control system on fuel economy. While this approach does not provide data on the effect of individual emission control components, it does yield valid data on the complete system's performance, which is the ultimate concern to the automobile user.

The choice of the test technique and of the type of data used in making this kind of analysis are important. To validly compare fuel economy figures so as to determine the effect of some change in vehicle design or construction (emission controls in this case) the test must hold constant all (or as many as possible) of the factors that influence fuel economy other than the factor under study.

A. Use of the Federal Test Procedure

As indicated in Section III. C, the test used in this analysis to derive the fuel economy figures is the Federal Emission Test Procedure, involving an urban driving route run on a chassis dynamometer under controlled temperature conditions. The advantages and disadvantages of using this procedure are summarized below.

1. Advantages

a. Ambient conditions are closely controlled, thus eliminating variability associated with this factor.

b. Exactly the same route is used every time. The vehicle must be driven over the same speed-time trace each time for the emission test to be valid. This eliminates variability in two factors: the route, and the driver.

c. The weight of the vehicle is known. Since the test procedure involves testing vehicles at a discrete inertia weight, the weight is known for every test and can be isolated as a factor.

2. Disadvantages

a. Since the driving cycle is an urban one, it is not possible to compute a "highway" fuel economy figure.

b. The rolling resistance of the dynamometer used in the test differs slightly from actual on-the-road rolling resistance.

These drawbacks do not, however, prevent valid comparisons regarding urban fuel economy or the overall fuel economy potential of various engine systems or engine/vehicle modifications. In addition, the measurement of CO and CO_2 and miles traveled during the test provides an accurate and repeatable method [2] of calculating fuel economy.

B. Data Sources

The data used as input for this study came from three major sources: EPA surveillance data, EPA certification data, and EPA inhouse data from various test and evaluation programs.

Use of the surveillance data of older cars can be challenged due to the fact that the older in-use vehicles may not be directly comparable to the 1973 certification prototypes, or to the advanced catalyst equipped prototypes, due to the possible effects of maintenance and mileage on fuel economy. It is, however, the only consistent data which exist for the earlier model years and until such time as data on the effects of accumulated mileage on MPG indicate otherwise, the aggregaton of all the data from the three sources is considered to be a valid assumption.

C. Use of "C" Factor and Display of Data

When the data are plotted as fuel economy (in MPG) versus inertia weight (IW) most of the data lies near the line represented by the equation MPG x IW = C, where "C" is a constant value for any given model year. In order to facilitate using a one parameter curve for each model year the value "C" was calculated in such a way to minimize the squared error. In this way the effect of inertia weight can be eliminated and the value "C" becomes an <u>indicator</u> of the average fuel economy for that model year. The percent loss or gain in average fuel economy for each model year (all vehicle weights) can then be determined by comparing the "C" values.

The average MPG figures for the various model years/inertia weights are shown in Table I. Appendix I contains tables which give the detailed data on average MPG and the range of MPG for the different inertia weights in model years 1957-1973. Figure 1 is a plot of the curves for pre-68 cars and 1973 cars as well as 75/76 prototypes and alternative engines.

TABLE I

MPG vs INERTIA WEIGHT AND MODEL YEAR*

Model Year	INERTIA WEIGHT 1750	2000	2250	2500	2750	3000	3500	4000	4500	5000	5500	# of vehicles in sample
57	N.D.	26.5	N.D.	N.D.	N.D.	N.D.	14.8	13.9	N.D.	N.D.	12.9	24
58	N.D.	26.2	19.5	N.D.	13.4	N.D.	14.2	14.4	12.8	10.1	N.D.	23
59	N.D.	29.4	N.D.	N.D.	N.D.	15.7	15.2	14.1	13.4	13.9	N.D.	25
60	N.D.	20.3	N.D.	22.8	24.4	N.D.	16.0	13.4	11.0	11.1	N.D.	19
61	N.D.	30.3	N.D.	21.1	17.6	18.2	13.1	13.5	10.6	N.D.	N.D.	26
62	N.D.	29.9	N.D.	N.D.	18.9	17.2	15.7	15.0	12.4	11.2	N.D.	51
63	N.D.	25.0	20.1	19.2	16.7	15.9	13.7	12.8	11.5	10.7	N.D.	76
64	N.D.	24.1	N.D.	N.D.	17.6	17.0	14.6	14.0	11.5	11.0	N.D.	94
65	N.D.	23.5	N.D.	N.D.	19.0	16.7	14.5	13.4	13.2	10.6	N.D.	137
66	N.D.	24.6	N.D.	N.D.	15.2	14.7	14.3	13.3	12.4	13.0	9.3	102
67	N.D.	24.7	30.6	N.D.	18.8	15.4	13.8	12.5	12.3	11.7	10.3	92
68	N.D.	21.5	20.8	19.3	19.5	15.4	13.3	12.1	11.6	8.8	N.D.	106
69	N.D.	23.1	20.4	19.7	N.D.	15.8	13.4	11.8	11.5	9.8	11.6	163
70	N.D.	24.5	21.1	17.8	18.9	15.6	13.5	12.1	10.9	10.2	9.7	287
71	27.4	21.9	21.2	19.6	18.5	15.2	13.0	11.3	10.6	9.3	8.1	148
72	N.D.	25.7	21.3	18.0	21.7	15.6	14.0	11.2	10.1	9.3	8.7	84
73	N.D.	25.5	20.7	19.9	17.9	16.2	14.0	11.2	10.1	9.4	8.8	630

*MPG figures for early model years (57-62) are based on limited data. This is partly responsible for the wide scatter in this early data.

N.D. - No Data

D. Effect of Emission Control on Fuel Economy

Many things can be inferred from the mass of data. What has been done here is to compare "C" values for each model year. The fuel economy penalties in terms of the constant "C" for model years 68 thru 73 are listed below.

TABLE II - Effect of Emission Control on Fuel Economy

Model Year	"C" Value	Fuel Economy Loss (% of Uncontrolled)
57-67 (Uncontrolled)	52129	None (baseline)
68	47108	9.6
69	47891	7.9
70	48320	7.3
71	47009	9.8
72	49362	5.3
73	48667	6.6

Average loss 68-73, 7.75%

The penalty due to emission controls as expressed above is far from the only cause of the increase in national automotive fuel consumption and can not be compared with total fuel consumption on a one for one basis. Factors such as increasing car population, the relative number of miles driven by controlled and pre-controlled cars, and the varying distribution of vehicle weight in each model year also have to be taken into account. These factors were not analyzed in this study and thus no conclusions concerning total nationwide impact on fuel consumotion are drawn.

E. Effect of Compression Ratio Changes

General Motors vehicles went to lower compression ratios across the board in 1971, and others have since done the same. To isolate the effect of compression ratio, data from one-hundred and seventeen 1970 and fifty-five 1971 GM cars of varying weight were examined.

TABLE III - Effect of Lower Compression Ratio, in MPG

Model Year	3500 lb	4000 lb	4500 lb	5000 lb	5500 lb
70	13.7	11.4	10.4	9.9	8.5
71	13.6	11.5	10.7	9.6	8.1

The fuel economy was worse in three weight classes, and better in two. These data do not demonstrate that lowering compression ratio had any effect on vehicle fuel economy.

V. IMPACT OF OTHER AUTOMOTIVE DESIGN FEATURES ON FUEL ECONOMY

To provide an appropriate perspective the data presented above need to be related to other fuel economy penalties being experienced in today's cars.

A. Air Conditioning

EPA laboratory tests of air conditioned full sized cars with and without the air conditioner operating show a 9% loss in fuel economy over the Federal driving cycle in a 70 degree F ambient temperature. This penalty can go as high as 20% (based on compressor hp calculations) for continuous use on a hot day in urban traffic. The penalty can obviously, also, be very low or zero when air conditioning is used little or not at all. The 9% loss measured in the EPA tests is approximately midway between these limits and is considered representative.

B. Automatic Transmissions

The fuel economy penalty associated with the use of automatic transmissions (AT's) is difficult to quantify. There are many types of AT's (different numbers of speeds, and different operating principles). The same engine will be tuned differently for use with an AT than for use with a manual transmission, and different rear axle ratios are used with AT's to optimize their performance. All of this compounds the problem of identifying the impact of AT's on fuel economy. Periodicals on the subject of vehicle performance have reported fuel penalties of 10% for AT's. On the other hand, as indicated earlier, an AT may in certain circumstances improve fuel economy. EPA does not have independent data on this question. In view of all the available data, EPA concludes that the fuel economy penalty of 5% to 6% reported by General Motors in public hearings in April 1972 is representative.

By comparing the fuel economy penalties of an automatic transmission or air conditioning with the penalty attributable to emission controls, it can be seen that the loss due to emission controls through the 1973 model year is about the same size as the penalty incurred due to use of convenience devices such as air conditioning or automatic transmissions.

C. Vehicle Weight

The fuel economy loss associated with emission controls is significantly less than that many vehicle operators claim they are experiencing. One major reason for this is that much of the decreased fuel economy observed is in fact attributable to the phenomenon of nameplate weight growth. When a nameplate, (Chevorlet Impala, for example) is first introduced, it identifies a vehicle weighing a certain amount. Over the years however, vehicles with the same

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nameplates have typically become heavier, a trend often unnoticed by the vehicle operator. The data in Table I and in Appendix I indicates the dramatic influence of weight on fuel economy. If one only compares the fuel economy of vehicles with the same nameplate (but different weights,) a conclusion regarding the impact of a non-weight parameter (such as emission control) on fuel economy will be wrong. The following example shows this effect:

TABLE IV - Effect of Vehicle Weight Growth on Fuel Economy

YEAR	CAR WEIGHT	NAMEPLATE	MPG
1958	4000 lb	Chevorlet Impala	12.1
1973	5500 lb	Chevorlet Impala	8.5

In this case, the additional 1500 lbs is predominatly responsible for the loss in fuel economy, not the emission controls.

VI. FUTURE TRENDS IN FUEL ECONOMY

A. The 1975/1976 Emission Control System

Very little valid or consistent data exists on fuel economy of 75/76 prototypes. Although some loss may be expected with the use of certain emission control techniques, the small amount of data available to EPA does not yet demonstrate any trends. This lack of trends is further supported by recent (Nov. 1972) reports from several large auto manufacturers who report no difference in the fuel economy of their 1975 prototypes and 1973 vehicles of the same weight.

TABLE V - Comparison of Fuel Economy of 1975/76 Prototypes with 1973 Vehicles

Vehicle Type	Inertia Weight	# of Tests	Prototype Fuel Economy	1973 Vehicles Average	1973 Vehicles Range
75 Prototype	4000	1	10.0	11.2	7.7-14.6
75 Prototype	4500	3	10.7	10.1	7.4-13.6
75 Prototype	5000	1	9.3	9.4	7.6-11.8
75 Prototype	5500	1	6.9	8.8	7.1-10.0
76 Prototype	5000	1	8.6	9.4	7.6-11.8
76 Prototype	5000	1	9.5	9.4	7.6-11.8
76 Prototype	5000	1	6.6	9.4	7.6-11.8

See also Figure 1.

Based on the limited data available from 75/76 systems, the only thing that can be said is that a trend toward better or worse fuel economy has not been demonstrated at this time.

B. Future Weight Trends

Vehicles have historically been getting heavier. Any influences which causes the weight to go up will reduce fuel economy. A major factor is the potential increase in vehicle weight due to future safety standards. The target weight for the Department of Transportation Experimental Safety Vehicle (ESV) was 4200 pounds. Automotive Engineering, September 1972 P.32, reports that the prototype vehicles had weights of 4900, 5300, 5400, and 5800 pounds.

If future vehicles in the standard size class increase as much as these prototypes (700 to 1600 lb) - fuel economy will suffer. As a hypothetical example, increasing the weight of the average 1973 4000 lb vehicle to 5000 lb could mean a drop in fuel economy from 11.2 to 9.4 MPG, a 16% fuel economy penalty.

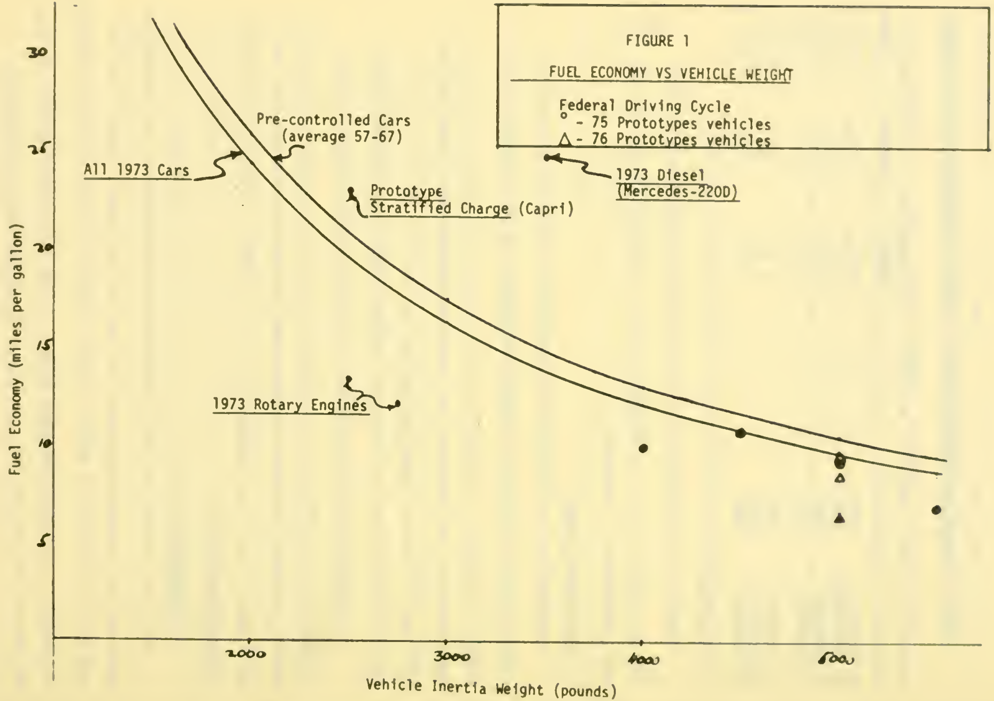
C. Future New Engines

1. Rotary Engine

While many engines are being investigated as replacements for the conventional spark-ignition, reciprocating engine, the one with the highest potential for near term use is the rotary, or Wankel, engine. Despite the recent increase in publicity, the Wankel is not a newly developed engine. It has been under development for over 20 years and in production for over 5 years by certain foreign manufacturers.

FIGURE 1

FUEL ECONOMY VS VEHICLE WEIGHT



The data available to EPA on fuel economy of rotary engine vehicles is presented below and compared to data on 1973 vehicles of the same weights but equipped with conventional reciprocating engines. See also Figure 1.

TABLE VII - Comparison of Rotary Engine Fuel Economy With 1973 Vehicles

Inertia Weight	Rotary Engine Vehicle	1973 Vehicles Average	1973 Vehicles Range
2250	14.6*	20.7	18.9 to 21.9
2500	13.3	19.9	13.3 to 23.7
2750	12.1	17.9	11.9 to 23.7
2750	12.3	17.9	11.9 to 23.7
2750	11.9	17.9	11.9 to 23.7
3000	14.9*	16.2	13.6 to 19.7

*Not 1973 vehicles.

The rotary engine fuel economy results are consistently at or near the bottom of the range in each weight class and are significantly below the average. The fuel economy data on the 1973 rotary engine vehicles represents a 35% loss in fuel economy when compared to the average for the same weight vehicles equipped with conventional engines. Historically, engines have improved in performance as their development continues and their use increases. Whether this will be the case with the fuel economy of the rotary engine is not known.

2. Diesel Engine

The Diesel engine is the only engine other than the gasoline, spark-ignition, rotary and reciprocating engines that is being used commercially in significant numbers in passenger cars in this country (approximately 6000 are imported each year). The Diesel, however, is not a new engine. It has been used in trucks for over 30 years and is widely used in passenger cars in Europe. The data available to EPA on the fuel economy of a diesel engine vehicle are shown below, and compared to that on 1973 vehicles of the same weight equipped with conventional engines.

TABLE VIII - Comparison of Diesel Engine Fuel Economy With 1973 Data

Inertia Weight	Diesel	All 1973 Vehicles Average	All 1973 Vehicles Range
3500	24.7	14.0	9.8 to 17.8

The Diesel (which in this case met the emission levels required by the 1975 standards) achieved 75% better fuel economy than the average 1973 vehicle of the same weight equipped with a conventional engine. See also Figure 1.

3. Other Engines

In addition to the Wankel and Diesel, several other engines are being considered as replacements for the gasoline, spark-ignition, reciprocating engine. These include stratified charge, Stirling, Rankine cycle and gas turbine engines.

For these engines, valid data exists for only the stratified charge engine. At an inertia weight of 2,500 pounds, a vehicle equipped with a stratified charge engine (which in this case met the emission levels, at low mileage, required by the 1976 standards) demonstrated fuel economy of about 23 miles per gallon or 12% better than the average 1973 vehicle of that weight. See Figure 1. Valid data on the fuel economy of the other possible engines is not available at this time.

VII. SUMMARY

The EPA has analyzed fuel economy data from more than 2000 cars (of which over 1400 were equipped with emissions controls) tested on the Federal Driving Cycle.

The data were derived from certification, surveillance and inhouse evaluation testing. This is the most extensive data analysis known to have been performed on this subject to date. It is also considered to be the most accurate for the purpose of comparing vehicle design parameters because of the use of a single consistent driving cycle and controlled ambient conditions.

The study indicates that vehicle weight is the single most important vehicle design parameter affecting fuel economy. Past and future increases in vehicle weight have had, and will continue to have, a significant adverse effect on fuel usage. Weight is a parameter over which the car buyer has direct discretionary control.

The average fuel economy loss due to emission control for 1968-1973 vehicles is less than 8%. This penalty is approximately equal to the penalty associated with the use of convenience devices such as air conditioning or automatic transmissions. Despite the many statements regarding the loss in fuel economy due to meeting the 1975/1976 standards, no significant trend has yet developed in the data available to EPA. EPA will continue to gather data on 75/76 prototype with the aim of making a more definitive statement in the future.

The use of engines other than the present spark-ignition, reciprocating engine could have a significant impact on vehicle fuel economy. Use of the spark-ignition, rotary engines presently results in significant losses in fuel economy, while the Diesel engine offers a significant increase in fuel economy.

VIII. CONCLUSIONS

1. Vehicle weight is the single most important parameter affecting urban fuel economy; a 5000 pound vehicle demonstrates 50% lower fuel economy than a 2500 pound vehicle.

2. The fuel economy loss for 1973 vehicles, compared to uncontrolled (pre 68) vehicles, is less than 7%. The average fuel economy loss due to emission control for all controlled (68-73) vehicles is 7.7%.

3. The fuel economy penalty due to the use of convenience devices such as air conditioning or automatic transmission is roughly equal to the penalty due to emission controls.

4. No trend is shown for fuel economy for 1975 and 1976 vehicles at this point in time. More data are needed.

5. Data on 172 1970 and 1971 GM cars did not demonstrate any effect on fuel economy of reduced compression ratio.

6. Future trends, including increased vehicle weight and possible use of the rotary engine, may result in a significant (20%-35%) fuel economy penalties.

7. The Diesel and stratified charge engines show better fuel economy then the conventional engine with the Diesel showing a fuel economy improvement of more than 70%.

8. Today's car buyer has available a choice of vehicles in terms of the size and weight, engine type, and convenience devices. These choices can influence a vehicle's fuel economy over a range of 4 to 1 (See Range of Data in Appendix I).

FOOTNOTES:

1/ Fuel economy should not be confused with fuel consumption which is expressed in terms of gallons of fuel consumed per mile. One is the inverse of the other. A certain percentage increase or decrease in fuel economy does not equal the same percentage decrease or increase in fuel consumption. For example, one car getting 20 MPG has 33% better fuel economy than one with 15 MPG. However its fuel consumption is 25% less. The two terms cannot be used interchangeably.

2/ Calculation of Fuel Economy

Since both CO and CO_2 are measured for the test, an approximate carbon balance fuel economy figure can be generated from the CO and CO_2 data. The formulae used are:

$$72 \text{ FTP MPG} = \frac{2360}{.429\,(CO) + .272\,(CO_2)}$$

Where the dimensions of CO and CO_2 are grams per mile for the complete test.

$$75 \text{ FTP MPG} = \frac{17800}{.429\,(CO) + .272\,(CO_2)}$$

Where the CO and the CO_2 are the total number of grams of CO and CO_2 in Bags 1 and 2.

Both of these formulae neglect the hydrocarbon contribution to the carbon balance. This however is not serious if the data are used for comparative purposes as is the case in this analysis. In addition, to the accuracy to which the data are reported, the neglect of the hydrocarbons influence is not important.

The accuracy of any single data point is believed to be within ± 5% of the true value. This is the maximum inaccuracy in the CO_2 measurement. The accuracy of the mean or average values is believed to be much higher since the experimental errors are random and tend to cancel out in the sample. No statistical analysis has been performed on this data. The data and conclusions presented on the preceding pages are based only on the observed means of the samples.

APPENDIX I

Inertia Weight	Average MPG	Range	# of Data Points
Model Year 1973	C = 48667		
2000	25.5	23.7 to 28.5	6
2250	20.7	18.9 to 21.9	8
2500	19.9	13.3 to 23.7	74
2750	17.9	11.9 to 23.7	62
3000	16.2	13.6 to 19.7	37
3500	14.0	9.8 to 17.8	64
4000	11.2	7.7 to 14.6	69
4500	10.1	7.4 to 13.6	157
5000	9.4	7.6 to 11.8	96
5500	8.8	7.1 to 10.0	57
Model Year 1972	C = 49362		
2000	25.7	21.4 to 37.8	5
2250	21.3	18.5 to 27.8	5
2500	18.0	17.0 to 19.0	2
2750	21.7	13.0 to 41.7	10
3000	15.6	10.1 to 20.6	7
3500	14.0	10.7 to 19.2	5
4000	11.2	6.3 to 15.3	28
4500	10.1	8.5 to 11.3	8
5000	9.3	7.8 to 10.6	11
5500	8.7	7.8 to 9.2	3
Model Year 1971	C = 47009		
1750	27.4	-	1
2000	21.9	19.3 to 23.9	6
2250	21.2	18.7 to 27.0	11
2500	19.6	14.7 to 25.0	16
2750	18.5	16.8 to 21.9	6
3000	15.2	7.8 to 20.7	10
3500	13.0	8.9 to 20.2	15
4000	11.3	8.8 to 13.6	42
4500	10.6	7.8 to 12.7	30
5000	9.3	5.4 to 15.4	10
5500	8.1	-	1
Model Year 1970	C = 48320		
2000	24.5	20.2 to 32.0	8
2250	21.1	13.1 to 40.1	7
2500	17.8	10.9 to 22.1	11
2750	18.9	15.8 to 20.2	9
3000	15.6	11.5 to 22.4	21
3500	13.5	9.4 to 17.7	65
4000	12.1	8.5 to 15.6	78
4500	10.9	7.3 to 13.3	51
5000	10.2	6.6 to 13.4	30
5500	9.7	8.3 to 12.2	7

Inertia Weight	Average MPG	Range	# of Data Points
Model Year 1969	C = 47891		
2000	23.1	15.3 to 26.0	14
2250	20.4	17.8 to 24.4	4
2500	19.7	18.1 to 26.8	13
3000	15.8	10.5 to 19.8	13
3500	13.4	9.8 to 17.4	37
4000	11.8	9.0 to 15.4	43
4500	11.5	9.1 to 21.2	31
5000	9.8	8.7 to 11.7	6
5500	11.6	10.2 to 12.9	2
Model Year 1968	C = 47108		
2000	21.5	19.9 to 23.6	8
2250	20.8	-	1
2500	19.3	-	1
2750	19.5	-	1
3000	15.4	11.9 to 19.8	15
3500	13.3	9.5 to 25.0	29
4000	12.1	8.8 to 14.8	31
4500	11.6	9.1 to 14.2	18
5000	8.8	8.7 to 8.9	2
Model Year 1967	C = 54170		
2000	24.7	20.0 to 33.0	8
2250	30.6	-	1
2750	18.8	17.9 to 19.7	2
3000	15.4	13.0 to 17.1	5
3500	13.8	11.5 to 18.6	21
4000	12.5	8.4 to 19.7	36
4500	12.3	9.7 to 13.4	16
5000	11.7	10.7 to 12.1	2
5500	10.3	-	1
Model Year 1966	C = 48934		
2000	24.6	20.5 to 31.2	6
2750	15.2	-	1
3000	14.7	12.0 to 16.9	16
3500	14.3	10.0 to 20.7	25
4000	13.3	8.6 to 28.8	34
4500	12.4	9.8 to 15.5	16
5000	13.0	10.9 to 16.9	3
5500	9.3	-	1

Inertia Weight	Average MPG	Range	# of Data Points
Model Year 1965	C = 50581		
2000	23.5	19.0 to 27.5	4
2750	19.0	16.4 to 21.2	8
3000	16.7	10.9 to 21.9	18
3500	14.5	8.4 to 21.8	42
4000	13.4	9.5 to 19.7	46
4500	13.2	7.4 to 27.8	15
5000	10.6	10.1 to 11.0	4
Model Year 1964	C = 50259		
2000	24.1	22.1 to 26.6	3
2750	17.6	16.3 to 20.5	8
3000	17.0	14.3 to 20.9	21
3500	14.6	10.2 to 29.8	28
4000	14.0	9.6 to 30.4	19
4500	11.5	8.6 to 15.5	12
5000	11.0	10.2 to 11.6	3
Model Year 1963	C = 48209		
2000	25.0	22.3 to 27.2	3
2250	20.1	-	1
2500	19.2	-	1
2750	16.7	14.4 to 21.2	8
3000	15.9	10.5 to 20.1	15
3500	13.7	6.0 to 19.0	19
4000	12.8	9.2 to 18.3	18
4500	11.5	9.3 to 13.5	10
5000	10.7	-	1
Model Year 1962	C = 56105		
2000	29.9	25.8 to 38.0	4
2750	18.9	17.1 to 20.6	2
3000	17.2	13.3 to 20.1	9
3500	15.7	13.2 to 18.6	10
4000	15.0	9.4 to 18.6	19
4500	12.4	10.5 to 14.3	5
5000	11.2	10.2 to 12.1	2

Inertia Weight	Average MPG	Range	# of Data Points
Model Year 1961	C = 53672		
2000	30.3	-	1
2500	21.1	19.9 to 22.2	5
2750	17.6	12.0 to 21.3	4
3000	18.2	17.5 to 18.9	2
3500	13.1	8.7 to 17.5	2
4000	13.5	10.5 to 17.1	9
4500	10.6	9.6 to 12.3	3
Model Year 1960	C = 52474		
2000	20.3	-	1
2500	22.8	-	1
2750	24.4	-	1
3500	16.0	15.1 to 16.8	2
4000	13.4	9.9 to 17.9	11
4500	11.0	10.6 to 11.4	2
5000	11.1	-	1
Model Year 1959	C = 56386		
2000	29.4	18.7 to 44.2	3
3000	15.7	15.3 to 16.1	2
3500	15.2	14.4 to 16.1	3
4000	14.1	10.6 to 17.7	13
4500	13.4	10.6 to 17.5	3
5000	13.9	-	1
Model Year 1958	C = 48095		
2000	26.2	-	1
2250	19.5	-	1
2750	13.4	-	1
3500	14.2	11.9 to 17.0	8
4000	14.4	10.8 to 20.2	9
4500	12.8	11.2 to 15.1	3
5000	10.1	-	1
Model Year 1957	C = 54537		
2000	26.5	23.0 to 31.9	3
3500	14.8	11.5 to 18.3	13
4000	13.9	9.4 to 21.6	7
5500	12.9	-	1

November 20, 1969

The White House Press Conference of Dr. Lee A. DuBridge, Science Advisor to the President; Walter J. Hickel, Secretary of the Interior; Clifford M. Hardin, Secretary of Agriculture; Robert H. Finch, Secretary of Health, Education, and Welfare; John A. Volpe, Secretary of Transportation; Dr. Ned Bayley, Director of Science and Education; and Edward N. Cole, President of General Motors Corporation, The Roosevelt Room

Mr. Ziegler. The Environmental Quality Council just completed its meeting. Dr. DuBridge, the Executive Secretary of the Council, will discuss with you, together with the other gentlemen who were present, the discussion today in the meeting.

Dr. DuBridge. Ladies and Gentlemen:

There was another regular meeting of the Environmental Quality Council. There were two items on the agenda; first, on the subject of automobile exhaust pollution, and secondly, the subject of pesticides. We will cover them in that order.

In order to participate in the discussion on automobile exhausts, we invited the Presidents of each of the four major automotive companies, and also the President of the American Petroleum Institute. They, with some of their staff people, joined in the meeting and participated in the discussion.

The Presidents of the companies—I think you have the list of them—were Edward Cole, President of General Motors Company; Mr. Virgil Boyd, President of the Chrysler Corporation; Mr. Ray Chapin, Chairman of the Board and Chief Executive Officer of American Motors; Mr. L. A. Iacocca, President of the Ford Automotive North American Operations and Executive Vice President of the Ford Motor Company; and of the American Petroleum Institute, Dr. Frank Ikard, the President. The gentlemen participated in the discussions.

First, Mr. Volpe, Chairman of a Committee of the Environmental Quality Council, Secretary of Transportation, presented on behalf of that Committee a proposed research program on improving automobile exhaust problems.

I will ask Secretary Volpe to say a word about their proposals.

Secretary Volpe: The Subcommittee of the Environmental Council composed of Secretary Finch, Secretary Stans, Secretary Romney and myself, gave a report to the Council with regard to what we believed to be desirable and necessary additional efforts in the field of research and development on unconventional vehicles or unconventional motors.

We believe that with the tremendous increase in automobiles, some 300,000 per month, compared to 180,000 babies per month in this country, that it is essential that we look at this total problem, and although we recognize the great efforts being made by the automobile industry, the petroleum industry and others, and the fact that the Department of HEW, under Bob Finch is setting up standards that will lower very considerably the amount of pollution, we believe we should also be looking at more fully the possibility of other types of engines that could be utilized in the automotive industry.

These were taken under advisement by the President and he will make an announcement as to his plans in the near future.

Dr. DuBridge: Thank you.

The President will then work out the detail of management and the budget of this program.

The next item had to do with the Department of Health, Education, and Welfare, and its responsibility for setting standards for automobile exhaust emissions, automobile emissions, as they affect the air quality.

I will ask Secretary Finch to say a word about his presentation.

Secretary Finch: We have, as of this point, laid down emission standards to ensure clear air and to protect health for about 90 percent of the urban population. We had discussions today about target dates in 1975 and 1980 with respect to what would have to be done in terms of controlling emissions, in terms of formulating fuels. It was a very satisfactory conversation, discussion.

I would anticipate that within about six months we would come up with new interim standards, because obviously the state of the art is changing all the time. We have in these various regions different kinds of problems and it was in this context which we had the discussions today, which I thought were very good.

Dr. DuBridge: The Secretary indicated some goals that the automobile industry and others should seek to attain during the next ten years and these goals were considered by the Council and discussed with the representatives of the industry.

Mr. Edward Cole of General Motors would like to respond on the industry's reaction to this discussion.

Mr. Cole: I think the industry has made very substantial progress toward achieving the clean air quality standards that are being talked about.

We further feel that the program that has been outlined to us here today by the Government can be achieved, providing we obtain enough time. We have the technical ability to do the job and handle it properly, but the question is of the manufacturing feasibility.

We completely concur with the objectives of the Government of reducing the air contamination and improving the air quality.

Dr. DuBridge: Thank you very much.

Are there any questions?

Q. What is being taken under advisement by the President?

Dr. DuBridge: The research program proposed by the Subcommittee chaired by Secretary Volpe to enhance the Federal activities and supporting research on conventional automotive engines.

Q. What do you mean by manufacturing feasibility, Mr. Cole?

Mr. Cole: Manufacturing feasibility, as we treat it in the laboratories we have been able to demonstrate the control of these pollutants to the level that is projected as being required. But when those are taken out of the laboratory and through the engineering process and the materials that have to be developed to withstand some of the environment to which these problems are directed, we do not have the availability of the materials at the moment, nor do we have the production capability.

So in the time frame that we are dealing with here, there is some serious engineering and field testing problems that must be solved.

Furthermore, in our particular case, if we have to practically guarantee the performance to these levels of pollutants that are being talked about today, that would mean that everyone of the 5 million cars we produce must meet these requirements. This is going to take some time and some testing so that we know when this is done we have achieved the objective that the Government is requesting.

Does that answer your question?

Q. Can I ask what time scale you are thinking of? However widely you have to bracket it, what time scale are you talking about?

Mr. Cole: Well, it is quite hard to predict the scheduling of ideas. We have not quite found a way to do that in our business yet. However, there is a substantial amount of work being done in this area and it is not, perhaps, so remote as might be indicated.

We do have hardware running. There are certain situations with these more exotic controls that cause some problems that we have not found the complete answer to. For example, if we should use an exhaust manifold reactor, this means that on the engine is attached a device that will cause a chemical reaction of these pollutants directly on the engine. Now if something causes more fuel to flow into this manifold reactor, then excessive temperatures can be experienced. As a result, there may be safeguards that have to be incorporated to protect the system against self-destruction.

Q. In other words, it might blow up?

Mr. Cole: It might blow up. [Laughter.]

Dr. DuBridge: The industry brought out the fact that each of the companies represented here are spending many millions of dollars a year on research on this problem now, and they have agreed to cooperate with the Government in pushing this program ahead.

In regard to the research program, I should have mentioned that as this program is adopted, this will involve the issuance of grants and contracts on the private sector of the economy to enhance their efforts towards the unconventional cars, and we would expect that a number of times as much money as has previously been spent by previous Administrations on this problem will be made available in the 1971 budget.

I think that completes our presentation on the automobile problem.

Q. Could I ask Mr. Volpe what size funds he is contemplating for this and what his time scale is?

Secretary Volpe: I cannot indicate to you what the scope of funds will be. That will have to come from the President.

Q. I mean what is needed?

Secretary Volpe: What is needed? You could use all the money you could get in this type of a program.

Dr. DuBridge: But not right next year.

Let us go on into the pesticide problem.

Thank you gentlemen.

In the field of pesticides, you have already seen some announcements; first the release of the report by Dr. Emil Mrak, formerly Chancellor of the University of California at Davis, which reviewed the whole subject of hard pesticides very thoughtfully and very carefully and made practical recommendations in regard to the reduction of the pesticide content in our environment.

The Secretary of Agriculture has a prime responsibility for determining the use of DDT and similar pesticides in the agricultural field, and the Secretary of HEW has the prime responsibility for watching over public health.

I think first Secretary Finch might say a word about the recommendations of the Mrak report.

Secretary Finch: I think the general thrust of the Mrak report is well known to you all. What needs to be pointed out is that since we announced the report being made to HEW, I have had continuing sessions and one joint meeting with Secretary Hickel and Secretary Hardin. This moved along and the steps that have flowed out of that meeting, as well as prior steps that the Secretary of Agriculture had taken, are listed here as immediate steps that will substantially reduce the amount of DDT and other hard pesticides being injected into the ecological stream or the total environment.

The steps that were taken today constitute an ongoing commitment insofar as the overall Administration is concerned.

In carrying out and implementing these programs, we are able to say with some greater precision now that well within this two-year time frame, we will have gone beyond 60 percent reduction in the total amount of DDT and other hard pesticides going into the environment.

It has been indicated that Secretary Hardin has had the primary responsibility insofar as most DDT affecting agriculture is concerned, and since he has taken the most dramatic steps, both before, during and after the Mrak report, I think I should let him speak about the steps his Department has taken and then we will hear from Secretary Hickel.

Secretary Hardin: I think most of the actions are detailed in the press release.

Q. Is this the first announcement of these?

Secretary Hardin: Yes. Several months ago we did eliminate the use of DDT under all of our Federal programs, including the forests, with one exception, control of the Douglas fir tusic moth for which it is specific, but none was required in 1969. So none has been used this season.

During the past three years already, cumulatively 34 registered crop uses have been discontinued. As of today, as indicated in the press release, we are cancelling the registration for all uses for shade tree pests, for pests in aquatic areas, house and garden pests and in both of these cases, except for control of disease vectors, that is insects that carry viruses or other disease organisms, upon recommendation of the public health officials. We have discontinued all use of DDT on tobacco.

Then, additionally, we are giving notice that all other uses are to be discontinued within 90 days or we are giving 90 days for comments from the industry and from the users, and if during this time there is objection, then the information will be studied by the three Departments involved, Interior, HEW and Agriculture, and decisions made as to whether the use should be continued, modified or discontinued at the end of this 90 day period.

Then, simply because of the pressure of numbers and the amount of work involved, we are beginning on March 1 the same kind of intensive program for the other hard chemicals, most of them being clorinated hydrocarbons, and during next year expect to have this entire program concluded.

One additional point, we have entered into a contract some months ago, with the University of Illinois, to study the whole matter of labeling. Result will be coming back, recommendations on that, soon.

Also, we have been working closely with industry groups, also, in the labeling area, to see if we can make the labeling more accurate, more helpful, more safe for the consuming public.

Dr. Bayley, do you want to add anything to that?

Dr. Bayley: That is fine, sir, unless they have some questions.

Q. Mr. Secretary, what do you mean by affecting human diseases?

Secretary Hardin: An example would be encephalitis as a result of a flood and insect invasion. It might be that we would have to move quickly or a great amount of human life would be endangered.

Q. What about controlling mosquitoes in a marshy area?

Secretary Hardin: Yes.

Secretary Finch: If there was not another reasonably soft pesticide that was available or effective, or the cost factor might be a factor, if they came to us—and that usually happens within a few days——and said, "We have to have this in order to stop this outbreak of typhus or malaria because of the insect population, that would be the kind of thing we would do when there was no other reasonable alternative available.

Secretary Hardin: The actions we have taken today will reduce the usage by about 35 percent in the United States.

Q. Mr. Hardin, what about the crops? Are there certain crops on which you will allow it, and who will decide about those?

Secretary Hardin: This will be decided during this 90 day period. This will be decided jointly by the Departments of Agriculture, HEW and Interior.

Q. If there is a conflict and the Secretary of Interior decides some pesticides may be used on a certain crop in his area of control, what happens?

Secretary Hardin: We will decide it together.

Secretary Finch: There is a two-to-one vote.

Dr. DuBridge: The Secretary of Interior has a participation in this. Do you want to say a word, Mr. Hickel?

Secretary Hickel: I don't really have much more to add. I think that collectively we have come up with an attainable and yet a very aggressive program. I think that the goals are reachable if that is the way to put it. I think the only question we had within our jurisdiction, as far as Interior is concerned, but out of the jurisdiction of the Cabinet Committee as a whole, was whether there was some way we should look at the amount of DDT, for example, that is being shipped, exported. That is a great amount and our concern is that we have jurisdiction over the Continental Shelf and various things in the ocean. So I think that that will be looked into. I think that we are making available to those nations that are buying the great amount of DDT that technology that we have at our disposal to make them aware of the problem.

But I think this is a great step forward, although there is some way to go yet.

Q. Dr. DuBridge, does this mean that the government has accepted the premise that DDT is harmful and cancer-causing?

Secretary Finch: It does not. It simply recognizes the fact that, as I said when I accepted the Mrak Report, that we have evidence of its being carcinogenic in animals. But we know that it has an enormous impact in terms of the overall environment and that it persists in the environment, and we think these are steps that are necessary to take, but we have no proof in terms of extrapolating between animals and humans that DDT is in fact carcinogenic.

We just have not had enough bodies around to perform autopsies on.

Q. What are some of the other persistent pesticides around that are about to come off the market?

Dr. DuBridge: I think Secretary Hardin mentioned persistent pesticides and it agreed that persistent pesticides are those which, when applied, last throughout a crop year or throughout a year if not on crops.

So, eventually, all persistent pesticides will come under this kind of control. Immediately, it is the DDT and similar products, but there are other persistent pesticides with long organic names which will also come under control. So that eventually we will be using primarily quickly degenerable, quickly disappearing pesticides that will not remain in the environment.

Q. Like the ones you commonly see on the shelf like Malathion and Dieldrin—are they considered persistent?

Secretary Finch: They are on the list to be evaluated. We need more information and more data. Part of the Mrak Report was that those specific drugs you mentioned should be given much greater scrutiny.

Q. What happens to the ground where they have already soaked in?

Secretary Finch: It is a little hard for us to extend our jurisdiction that far. That is our problem there. (Laughter) The other recommendation that came from Dr. DuBridge that goes beyond the Mrak Commission report, which relates to our responsibility internationally, is the fact that there is added to this environmental quality control subcommittee, the State Department, so that we get the information to the other countries and let them make decisions with respect to how they want to use it—because many of the emerging nations will say "We want DDT", better than 70 percent of our DDT is shipped abroad now—and the Defense Department because they use so much of it, and I think there was one other department.

Dr. DuBridge: And also AID and Transportation. There is a question that was raised a moment ago about Malathion. Dr. Bayley of the Agriculture Department would like to clarify that.

Dr. Bayley: I just wanted to make it clear to the person raising the question which included Malathion that we do not consider this one of the persistent pesticides. Dieldrin, Endrin, Chlordane and some of the others are involved.

Q. Can you explain when the notice of cancellation is given and then it takes effect within 30 days, does that mean starting today they have 30 days?

Dr. Bayley: There is a technicality here. On the first action regarding the uses, they have 30 days to appeal that action. This is according to law. We issue to the manufacturers a notice of immediate cancellation, but they do, according to law, have 30 days to appeal this.

On the second action, we issue a notice of intent to cancel. They have 90 days to make their comments on this before we decide what the final action will be.

Q. But you are banning it, really, within 30 days. You are banning it now and within 30 days it will be illegal?

Dr. Bayley: The word "banning" is not appropriate. We are cancelling certain registered uses.

Secretary Finch: Which means you cannot use it. [Laughter]

Dr. Bayley: But the word "certain is very important so we do it in a responsible way.

Q. What about aerial applicators, for example, who have large inventories of DDT, what do they do with it?

Dr. Bayley: For these particular uses? They will have to find some other use for it.

Q. Does Number 2 say now that the Secretary of Agriculture does no longer issue the registration?

Dr. DuBridge: No, certainly not. The interagency agreement is that the three Secretaries, Agriculture, HEW and Interior, will form a group to work together on any action which is taken by each of them in connection with the pesticides. Now, by law certain responsibilities are alloted to each of these three agencies, and therefore, each must carry out its responsibilities, but they will do it in collaboration with the other agencies.

So, the first thing is that there is this new expanded inter-agency agreement whereby these three Secretaries will work closely together. So that as registrations are cancelled for crop use, which is Secretary Hardin's responsibility, he will do this after consultation with Interior and HEW. If HEW sees health hazards involved in agricultural use, the Secretary will advise the other Secretaries of this and so on.

Q. How about new products?

Dr. DuBridge: The same thing, if it is clearly a persistent pesticide, yes. I think it is important to emphasize what Secretary Finch said, that there is also established, as indicated here, a new committee of the Environmental Quality Council under which there will be a working group to continue coordination throughout the government and particularly to watch over the international problems, as well as the problems of use by DOD and Transportation and the export problems under AID.

Q. Will DDT still be used in the United States 90 days after today or will it not? I am just confused.

Secretary Finch: Yes.

Q. If so, under what conditions?

Secretary Finch: On an emergency basis. I would have to let Secretary Hardin speak to a given crop in a whole given area where the crop would be jeopardized, for example, if a reasonable alternative to DDT were not available. If we had a major catastrophe, a hurricane or that sort of thing where they demanded and did not have a pesticide that could do the job and our local public health officials told us that was the case, we would then move in with that.

Q. Then other than emergency situations, the courts are not going to stay this order or there is not going to be an appeal that you are going to hear and allow DDT to be continued in use after 90 days from today?

Secretary Finch: There are other items that have DDT in them, in your garage and in some kitchens. Frankly, so far as our jurisdiction is concerned, I will go back to Chancellor Mrak and we will phase those out, but we will do it on a phased basis within this time span I have indicated. There are small amounts of hard pesticides in those. So you cannot say you will not have DDT being used.

Obviously, Agriculture has been using the most of it, is concerned with the use of most of the DDT.

Q. Secretary Finch, did you say that we are going to continue manufacturing DDT for export to other countries or you are taking it into consideration?

Secretary Finch: We are saying we are broadening in this Commission in the Environmental Quality Council to consider international impact of this. The World Health Organization, many members of that, and as I said, many of the emerging nations, say, "We have to make a decision and we would like more people to live to be more than 20 years of age and get rid of typhus and malaria and that is something that has to be very delicately negotiated. It is not for us to lay down the established standards for them. We will do it after consultation

Dr. DuBridge: There are many countries in which disease-bearing insects are far more dangerous than in the United States. It would be tragic if they were not allowed to have this method of controlling these very dangerous diseases that are now borne by certain insects, fleas, lice, mosquitoes, flies and so on.

But we hope to extend an educational program and extend to other nations knowledge of other materials which can be used in certain cases and help them to solve their problem so that they will not have to use the stuff either if it is possible to get out of using it.

Q. You said 70 percent of the DDT production is used for export.

Secretary Finch: Roughly. It may be a little higher than that. In all fairness, you have to realize that the so-called producers of the hard pesticides—and these are very loose terms to use because you get into different kinds of families and almost a kind of incest—but they have been moving from the hard pesticides to the soft pesticides generally so that they have been anticipating this. There has been enough advance notice so that in many areas they have been anticipating and replacing the hard pesticides with the soft pesticides which do not stay in the system so long.

The Press: Thank you.

CONFIDENTIAL MEMO

SMOG CONTROL ANTITRUST CASE

(Mr. BURTON asked and was given permission to address the House for 1 minute, to revise and extend his remarks and include extraneous matter.)

Mr. BURTON Mr. Speaker, on September 13, 1969—see CONGRESSIONAL RECORD for that date—I joined with 17 of my colleagues in urging an open trial in the smog control antitrust case.

Just this week I have received a document which I am offering today for my colleagues to examine, a document presented to me by reliable persons, and which is described as a confidential memorandum of the U.S. Department of Justice. This memorandum recommended to the Attorney General that criminal charges be brought against American auto manufacturers for conspiring to retard the development of a smog-free motor vehicle.

This memorandum, which spells out in detail previously undisclosed evidence, was prepared before January 10, 1969, when the Department of Justice decided to proceed with a civil suit. Subsequently, the Department of Justice agreed to settle the matter with a consent decree.

These disclosures are especially painful in light of the settlement of the Government's civil case in September 1969 which was filed in lieu of any criminal case. This settlement by a consent decree increased the legal burdens for later litigants, failed to provide for any restitution of damage done, failed to contain adequate reporting requirements, and failed to prohibit the destruction of past documents—all in tradition of ex parte negotiations which form the cornerstone of the consent decree program.

I release this document today because I agree with the metaphor principle behind Louis Brandeis' statement that "sunlight is the best of all disinfectants." Public exposure of these formerly secret materials can only serve to educate the people as to the industry's capability for a major health problem. The consent decree settlement deprived the public of an open trial on all the issues. An open trial would educate the unreformed and deter the potential violator, especially in the auto industry which has for too long been dealt with by gentlemanly trustbusters in the shadow of Government. Sunlight will do it well.

The material follows.

PROPOSED DEFENDANTS AND COCONSPIRATORS

PROPOSED DEFENDANTS

Corporation and State of incorporation

Automobile Manufacturers Association, Inc. New York

General Motors Corporation, Delaware

Ford Motor Company, Delaware.

Chrysler Corporation, Delaware

American Motors Corporation, Maryland

The entire conspiracy was organized and nurtured in and operated through the Automobile Manufacturers Association (AMA), the trade association of the automobile industry with a membership of nearly 99% of all domestic car and truck manufacturers. The Board of Directors of AMA made all policy decisions in the motor vehicle air pollution control field and the members adopted those policies. AMA is, therefore, proposed to be named as a defendant.

The big four of the industry—General Motors, Ford, Chrysler, and American Motors—were most active in the conspiracy primarily because they were most affected financially if required to install pollution control devices on the millions of cars they manufactured annually, amounting to a vast majority of all domestic car production. General Motors, Ford, Chrysler, and American Motors are, therefore, proposed as defendants.

The conspiracy, which started at least as early as 1955, has lasted so long that many of the participants have abandoned their participation by severing connection with the employers they represented by retirement or otherwise. Too, so many people were involved on behalf of the companies involved that it would be unrealistic to name them all as defendants. The following representative officials who were active in the conspiracy were selected, therefore, as proposed defendants.

PROPOSED COCONSPIRATORS

Corporations and State of incorporation

Checker Motor Corporation (successor to Checker Cab Manufacturing Corporation), New Jersey

Diamond T Motor Car Company, Illinois.

International Harvester Company (a consolidation of International Harvester Company, a New Jersey corporation, and International Harvester Corporation, a Delaware corporation), Delaware

Studebaker Corporation (successor to Studebaker-Packard Corporation), Michigan.

White Motor Corporation (successor to The White Motor Company), Ohio.

Kaiser Jeep Corporation (successor to Willys Motors, Inc. a Pennsylvania Corporation), Nevada.

Mack Trucks, Inc. (successor to Mack Manufacturing Corporation), New York.

INDIVIDUALS PROPOSED AS COCONSPIRATORS

All members of the Board of Directors of AMA from January 1, 1953 to the date of the indictment, other than those named as defendants herein.

All members of the Engineering Advisory Committee of AMA from January 1, 1953 to the date of the indictment, other than those named as defendants herein.

All members of the Vehicle Combustion Products Committee of AMA from December 4, 1953 to the date of the indictment, other than those named as defendants herein.

All members of all Task Groups which were subcommittees of the Vehicle Combustion Products Committee from December 4, 1953 to the date of the indictment

All members of the Patent Committee from January 1, 1953 to the date of the indictment.

———, employed by AMA, acted as its liaison officer between it and its members in the air pollution control equipment field and also as its representative before state, county, and local boards and agencies concerned with motor vehicle air pollution control.

The foregoing corporations are all AMA members and signatories to the cross-licensing agreement, the vehicle about which the conspiracy revolved. They are, therefore, proposed as co-conspirators

The other proposed co-conspirators are the many participants in the conspiracy.

BACKGROUND

Air pollution is a national problem. Polluting emissions from automobiles is one of the causes. Because of the topography[1] of Los Angeles, California and the high concentration[2] of automobiles in that area, the problem was first recognized by the country and then California state officials, and efforts to compel remedies were first imposed there. This memorandum relates to collusive activities of the automobile manufacturers in connection with research, development, manufacture, and installation of motor vehicle air pollution control devices. As background, the Los Angeles story is important.

The word "smog," derived from abbreviations of smoke and fog, is a misnomer. What is commonly called "smog" is really the result of chemical reactions that take place in polluted air, heated by the sun's rays, and is evidenced by one or more effects much as eye irritation, reduced visibility, high ozone concentration, plant damage, and odor. It is recognizable by a "brownish" or "bluish" haze which many times obscures the surrounding mountains.

The air pollution control program was commenced by the State of California in 1947. In early 1951, Dr. Arie J. Haagen-Smit, a renowned research chemist at the California Institute of Technology, discovered that when oxides of nitrogen, ozone and gasoline (hydrocarbon) vapors were introduced into a plexiglass test chamber and exposed to ultra violet light (artificial sunlight), an irritating haze with all the properties of natural smog was formed. It was this research that pinpointed the motor vehicle as one of the major sources of air pollution and became known as the Haagen-Smit or hydrocarbon theory of smog formation.

Following the publication and general acceptance of the Haagen-Smit theory, the automobile industry finally acknowledged that motor vehicles contributed to air pollution, which it had steadfastly denied prior thereto. The problem of how to control motor vehicle emissions was then turned over by the industry to the Automobile Manufacturers Association (AMA), of which all the automobile manufacturers were and are members

From the very outset the industry realized that air pollution control devices do not help sell automobiles (Tr. Vol XXXVIII, p 11, Tr. Vol. LVII, p 170).

In his testimony (Tr. Vol. XXXV, pp 32–33), Supervisor Hahn of Los Angeles County confirmed the following statement appearing in Ralph Nader's book, "Unsafe at Any Speed" at page 100.

"When Mr. Hahn went to Detroit to get some direct answers about adoption of exhaust controls, a senior official of one of the companies asked: 'Well, Mr. Hahn, will

Footnotes at end of article.

that device sell more cars?' 'No,' said Mr. Hahn. 'Will it look prettier, will it give us more horsepower? If not, we are not interested.'"

A letter of November 17, 1938 from Lloyd Withrow, head of the Fuels and Lubricants Department of General Motors (GM), directed to Dr L. R. Hafsted of that company, states in part: "financing this work is most expensive, and the incentives for carrying it out are closely related to political considerations." The letter goes on to state that "[t]he development of exhaust control devices cannot be justified on a business basis; the only hope of a return on such an investment is possible legislation requiring their use." After pointing out that none of the devices contribute appreciably to the efficiency, performance, or appearance of the automobile, the letter concludes that on account of the reasons advanced, "the managements of Corporation Divisions are reluctant to undertake the engineering and development of devices, even though they appear to be based on sound principels." (Tr. Vol. XXXVII, pp. 101–106; GJ Ex. 525).

While the general public talks a lot about air pollution, most people prefer doing without control devices rather than to pay for them. As a result the industry engaged in lip service concerning the health and welfare of the community and the necessity for prompt research, development, and installation of motor vehicle air pollution control devices. In fact, as hereinatfer shown, the automobile manufacturers, through AMA, conspired not to compete in research, development, manufacture, and installation of control devices, and collectively did all in their power to delay such research, development, manufacturing, and installation.[3] Indicative of tihs industry attitude is the very firm position taken in regard to the California authorities, as reported by Dr. J. D. Ullman of E. I. Du Pont after a visit to Detroit in January, 1960:

"Basicaly, the automotive manufacturers would seek to avoid installing a reactor of any sort on a car because it adds cost, but provides no customer benefits such as improved engine performance or styling advances. From this thinking [the following fact, among others, evolves]:

"(1) A smog abatement device will be installed on cars for California market only after being approved and requested by the Government of California. The industry has told California that cards will be equipped with devices designated by California one year from the date of designation." (GJ Ex. 194).

Also, failure on the part of the manufacturers to purchase devices of independent companies, produced at costs of millions of dolars, discouraged such independents from further research, development, or manufacture of control devices to the great detriment of the American people, science and industry.

An AMA internal memorandum prepared for presentation at Vehicle Combustion Products Committee (VCP) and Engineering and Advisory Committee (EAC) meetings disclosed that as recently as January 15, 1965 the same dilatory considerations prevailed.

"On the basis of the facts the industry is not convinced that exhaust emissions devices or systems are necessary for nationwide application to motor vehicles but believes instead that they will be an economic and maintenance burden on motorists. It is, therefore, not prepared or desirous to initiate any voluntary program to impose these systems or devices on all customers nationwide, or to accept the responsibility for such a decision, in the face of a lack of convincing evidence." (GJ Ex. 411).

The seriousness of the basic problem of air pollution in Los Angeles is highlighted by the following statistics: As late as January 1967, even with the installation of air pollution control devices compelled by law, 12,465 tons out of a total of 14,601 tons per day of contaminants within Los Angeles County are caused by gasoline powered motor vehicles, or in other words, 85.3% of all contaminants in the area are still caused by motor vehicles. (GJ Ex. 486).

THE AUTOMOBILE MANUFACTURERS ASSOCIATION

The AMA is a trade association whose members manufacture 99% of the cars, trucks, and buses produced annually in the United States (Tr. Vol. XX, p. 53; Tr. Vol. XXI, p. 124, GJ Ex. 394). The policies of AMA are made by and the activities of AMA are carried on under the direction of its Board of Directors. (Tr. Vol. XX, p. 59). The Board of Directors is comprised of the President and Chairman of the Board of the automobile and truck companies who are members of the Association (Tr. Vol XVII, p. 5). Until recently,[4] the President of AMA was chosen from among the members of the Board of Directors. (GJ Ex. 255 and 300).

Most of the work of AMA is done by committees. (Tr. Vol. XVII, p. 6). When the air pollution control program was commenced, the VCP, a subcommittee of the EAC (which consists of the Vice-Presidents in charge of the engineering department of each member company), was established by the AMA (Tr. Vol. I, pp. 88–90, GJ Ex. 260; Tr. Vol. XXXXVI, pp. 52–56, GJ Ex. 565). Membership in the VCP consists of project engineers of the various member companies. (Tr. Vol. XXXXV, p. 32). The following excerpts from documents and testimony illustrate the broad scope of the assigned VCP responsibilities.

"The Vehicle Combustion Products Committee of the Automobile Manufacturers Association which has been assigned the responsibility for the past four and one-half years of conducting an intensive cooperative program dealing with all aspects of the automobile exhaust problem . . . (GJ Ex. 258, excerpt from draft, dated March 10, 1958, prepared for presentation to House Safety Committee).

"As the role of the automobile in smog formation was being disclosed, the AMA Board of Directors, in 1954, instructed industry engineers to look into the situation immediately and make recommendations for industry action.

"INDUSTRY ACTION

"As a result of this investigation, the AMA Board decided that the problem should be dealt with on an industry team basis. Accordingly, it formed the Vehicle Combustion Products Committee to direct all industry efforts on a non-competitive basis." (Tr. Vol. XXXXVI, pp. 52–54; GJ Ex. 565).

Mr. Robert T. Van Derveer, director of Motor Vehicle Components Laboratory, United States Department of Health, Education and Welfare, formerly head of the Fuels and Exhaust Emissions Department, American Motors Corporation (American), testified that this noncompetitive industry-wide approach concerned not only research and development, but also the installation and marketing of devices; that is, that all aspects of company activity in this field were to be coordinated through the AMA (Tr. Vol. XXXXVI, pp. 53–55).

A number of task groups report and make recommendations to the VCP on specific areas of the automobile which affect emissions: e.g., the Crankcase Ventilation Task Group, the Exhaust System Task Group, and the Fuel System Emission Task Group. (Tr. Vol. XVII, pp 8–10).

The VCP in turn reports and makes recommendations to the EAC. (Tr. Vol. XVII, p. 6). The following excerpt from GJ Exhibit 335, (Tr. Vol. XX, pp. 56, 61–62) sheds light on the role and composition of the EAC:

"The industry cooperative program is directed by the AMA Board of Directors but is under the technical control of our Engineering Advisory Committee whose chairman, Herb Misch, of Ford Motor Company, will preside this noon. Mr. Misch and all of the other members of the Engineering Advisory Committee are vice presidents in charge of engineering affairs of their companies and are therefore in an excellent position to direct the technical activities which are carried on by the Vehicle Combustion Products Committee and its various working groups and panels."

The EAC in its turn reports and makes recommendations to the Board of AMA. (Tr. Vol. XX, p. 63). It is, however, the Board of Directors which makes all of the policy decisions of AMA (Tr. Vol. XX, pp. 59, 62; Tr. Vol. XXXXVI, p. 4).

Footnotes at end of article.

THE CONSPIRACY

As early as 1955 and even prior thereto, public speeches and statements made by the top brass of the leading automobile companies heralded the fact that cooperative effort was being undertaken in the automobile industry in order to accomplish a solution to the motor vehicle air pollution control problem as expeditiously as possible.

In a speech made on April 18, 1955, James C. Zeder, then Vice President of the Chrysler Corporation (Chrysler), said:

"Perhaps you are somewhat surprised to find that we are acting cooperatively in the battle against 'smog.' Our industry has a reputation for being fiercely competitive, and we're proud of it. Ordinarily, competition in research and engineering, as well as in production and sales, can be proved to be the best way to get maximum results and progress. The automobile industry and business has been demonstrating this for more than 50 years. But it has also demonstrated that under some conditions, where the public interest is primarily involved, it is possible to get to a solution of a problem quicker by sharing knowledge and by helping each other bear the work load. At such times we cooperate as energetically as at other times we compete." (GJ Ex. 326).

Similarly, in the language of Charles A. Chayne, then Vice President of General Motors and Chairman of the EAC in 1954:

"Before I go further, therefore, let me pause to add my personal salute to the civic spirit that launched the cooperative program, 'Operation Teamwork' which went into effect last August. It is the kind of teamwork which we have adopted in the automotive industry on a number of historic occasions when it was obviously more beneficial to the American people generally for us to set aside for a time our concern about the immediate advantages of competitive action, and apply the combined talents and facilities of the whole industry to the solution of some problem that affected the public interest adversely." (GJ Ex. 583; Cf. Remarks of John F. Gordon, President, AMA, and President of GM, July 31, 1963, GJ Ex. 335, p. 2 of remarks).

Minutes of the Engine and Vehicle Modification Task Group Meeting, September 12, 1962, gives the source of AMA policy in this matter as follows:

"The AMA Board of Directors has instructed the Engineering Advisory Committee to solve the vehicle emission problem through industry co-operative effort and to explore any and all avenues necessary to accomplish this." (GJ Ex. 286; Cf. GJ Ex. 258).

On February 7, 1955, the VCP in accordance with a directive of the Board of Directors submitted in draft a plan whereby an information pool would be established and that "research and test data, devices, methods and the like, whether or not the subject matter of a patent or patent application, as may be submitted by any Vehicle Manufacturing Company to the VCP Subcommittee, and owned or controlled by such Company, are to be available on a royalty-free basis to all Vehicle Manufacturing Member Companies and such non-member companies as the VCP Subcommittees may select which agree to conform to the terms of the Resolution of the Board of Directors approving this report (GJ Ex 260, p 1a, Cf GJ Ex 285, p 4)

The plan, however, was never adopted. In place thereof, the Board of Directors of AMA "instruct[ed] legal counsel and the AMA Patents Committee to develop a Cross-Licensing Agreement which was the key part of the implementation of the cooperative research and development program." (GJ Ex 258, AMA Staff Report on Smog Problems to Board of Directors, p. 1) The cross-licensing agreement limited the field of activity to six categories The Patent Committee Minutes of April 5, 1955 at which this plan for a formal cross-licensing agreement was adopted, contains the following statement (similar ones of which were made many times thereafter by the project and industry leaders) "Mr. Heinen has repeatedly expressed the feeling of his Committee (the VCP) that no one company should be in a position to capitalize upon or obtain competitive advantage over the other companies in the industry as a result of its solution to this problem." (GJ Ex. 292)

This position and its antitrust implications are indicated in a May 10, 1954 AMA document authored by Mr G. J. Gaudson, former secretary of the VCP, now Detroit Branch Manager of the Society of Automotive Engineers (SAE), as follows.

"Heinen asked whether a company coming across a satisfactory device either submitted by an inventor, developed during the course of normal company research, or during the course of Subcommittee studies should make the device and its details known to the other companies participating in the Subcommittee work The alternative, of course, would be for the company to say nothing and then 'scoop' the other manufacturers with an anti-smog device. In view of the common importance of the smog problem to all of the companies and in view of the satisfactory cooperative nature of the work thus far, the individual company approach was not generally favorable However, it was recognized that very serious legal problems might be involved in the cooperative acceptance and review of devices." (GJ Ex. 590).

Mr J. M. Chandler, then Unit Supervisor of the Engineering Research Department, Engineering Staff, Ford Motor Company (Ford), in an intracompany communication dated November 18, 1964, wrote in part:

"LEGAL ASPECTS OF COOPERATIVE ACTION

"Another subject discussed at this VCP meeting was that of the legal complications involved in a cooperative industry solution to the smog problem. Mr. Cronin, General Manager of the Automobile Manufacturers Association, indicated that the legal study had not yet been completed, and that he was not sure how complex it was going to be. There is some difficulty concerned with antitrust action which is being carefully surveyed The Subcommittee indicated a general moral feeling of free cooperation, but with no binding agreements legally available, there is still some question as to competition versus cooperation Whatever the legal solution it would not hurt for us to be competitively prepared." (GJ Ex 593).

To the same effect, the Minutes of the Patent Committee of April 5, 1955, read in part as follows:

"In discussing the need for a formal agreement as opposed to adoption by the member companies of a Board resolution accepting the report on purpose and procedure, Mr. Willits pointed to the cross-licensing agreement employed between the lamp and automobile manufacturers in solving the headlighting problem."

* * * * *

"Mr Willits raised some fundamental questions as to the extent of accomplishment possible through a cooperative arrangement such as that contemplated here, as opposed to the progress which might be achieved from the strictly competitive approach. It was agreed that, from the standpoint of public relations, concerted action by the members of the industry and their suppliers appeared to be the only satisfactory solution to the problem." (GJ Ex. 260)

The cross-licensing agreement was originally entered into in 1955 It was amended in 1957 and again in 1960. Five year extensions were executed by the signatories in 1960 and 1965. Thus, the basic provisions of the cross-licensing agreement are in effect today (GJ Ex 263, 264, 265, and 266). It provides for a royalty-free exchange of patents between the participants and a formula for sharing the costs of acquisition of patents. The provisions of the cross-licensing agreement which accomplish this result are as follows:

"ARTICLE III—LICENSES GRANTED BY EACH PARTY

"(a) Each party to this Agreement grants to each of the other parties and to their respective subsidiaries, a royalty-free, non-exclusive license to make, use and sell and to have others make for it or them Licensed Devices and parts thereof coming under any patents, domestic or foreign (subject to the conditions set forth in paragraphs (b) and (c) of this Article), owned or controlled, either directly or indirectly, by said grantor on July 1, 1955, or at any time thereafter prior to June 30, 1960, or granted at any time hereafter on inventions owned or controlled, either directly or indirectly, by said grantor on July 1, 1955, or at any time thereafter prior to June 30, 1960.

* * * * *

"(c) If any of the parties hereto acquires directly or indirectly a patent otherwise coming within the scope of this Agreement at a cost, exclusive of the expense incurred in prosecuting the patent application or negotiating the purchase, in excess of three hundred dollars ($300), no license thereunder shall be acquired by any other party by operation of this Agreement except upon such party sharing the cost of the patent equitably with the first party and with any other parties electing to take a license thereunder." (GJ Ex 263).

Section (a) provides for a royalty-free exchange of defined patented devices by all participants provided that development costs in excess of $300 are shared equally. As hereinbefore stated, there is admittedly little or no economic incentive for automobile manufacturers to develop and install air pollution control equipment on vehicles they manufacture. (Tr. Vol. XXII, p. 54). Since the results of any industry advances are to be shared by all, there is no private incentive for gain inasmuch as each company must share the benefits of such advantages with the rest of the automobile industry (GJ Ex. 566). Delays in technological development engendered by inadequate manpower or facilities will result in no disadvantage to any company should it become desirable or necessary to install such equipment in the future At the same time it is apparent that the participants in the cross-licensing agreement possess sufficient resources to engage in competitive research and development programs

Section (c) provides for a royalty-free exchange, between the participants, of patents acquired from third parties, provided that the purchase price in excess of $300 is shared equally. In effect, this provision presents a third party seeking to market a patent to automobile companies with but a single purchaser—i.e., the whole industry. The provision eliminates price competition among the participants with respect to the purchase of patents from third parties (Tr. Vol XXII, p 53)

The intent to control prices of inventions by the cross-licensing agreement is shown by the fact that this agreement, including the above-quoted provision, was modeled after a similar agreement concerning sealed beam headlights In discussing this agreement a report of the VCP dated January 10, 1958 reads in part "There are some industry precedents established in the arrangements which the industry made to insure multiple sources for Sealed Beam headlight units, and *to set the terms for the maximum royalties to be paid for use of light polarizing material*." (GJ Ex 338, underscoring supplied)

The cross-licensing agreement provides a most "favored nation clause" whereby third parties must license all participants at the same royalty rate (Tr Vol XXII, p. 48) The provision of the cross-licensing agreement which accomplishes this result is as follows

"ARTICLE III—LICENSES GRANTED BY EACH PARTY

"(b) If any party hereto as acquired or does in the future acquire either directly or indirectly the ownership, control, or right to license others under patents otherwise coming within the scope of this Agreement conditioned on the payment of royalty, no license thereunder shall be acquired from such party by any other party by operation of this Agreement except upon the latter's agreeing to pay and paying to the licensor of said first party, royalty at the same rate as such first party would have been required to pay had the licensed article been made or sold by it. Royalties accruing under the provision of this subsection (b), if for sales within the United States and Canada, shall be payable in the next succeeding month of January, April, July or October, as the case may be, following the close of the calendar quarter in which said sales occur. . . . (GJ Ex. 263).

Mr. William L. Scherer, manager of the Patent Department of AMA, interpreted the meaning of this provision for the grand jury He testified that it enables any other party to the agreement to obtain the same kind of arrangements with respect to rights as the first party making arrangement with a patentee. (Tr. Vol. XXII, p. 46). In other words, if one of the companies acquires a license under a given patent, that company must endeavor to make it possible for any other party to the agreement to also obtain a license under that patent, for which royalty would be paid at the same rate as the first company acquiring rights under the patent would have negotiated. (Tr. Vol. XXII, p. 47). This ensures to anyone else who may want to come into the program, or use that patent, that they will get the same royalty treatment as the first individual does. (Tr. Vol. XXII, pp. 48–49).

This provision of the cross-licensing agreement was intended by the participants to eliminate competition between them in the purchase from third parties of rights under existing patents. This conclusion is based on Mr. Scherer's testimony which was as follows:

"The JUDGE Wasn't the patentee told that it would be available to all of the companies? Or was that kept a deep, dark secret?

"The WITNESS No, I think that when he came, for instance, if John Doe has a device that he says will solve the problem, and he wanted to come to Company A and deal with that company, he could have done so.

"Now, the only understanding is that, if that John Doe, I believe I called him, were to deal with Company B, the only understanding is that he is going to get the same royalty arrangement that Company A has.

* * * * *

"The WITNESS And he will be glad to do that, believe me.

"The JUDGE. Well, in other words, he might go into Company A and agree on a royalty of 10¢ an item, let's say.

"The WITNESS. Yes.

"The JUDGE. Now, he went to Company B and he is faced with the fact that that is as much as he can get, is 10¢, because the other company has now made it available to them.

"The WITNESS. That's right. But, remember, he has got a lot more volume.

"The JUDGE. Well, that may be so or it may not be so. But, it depends on, in other words, his 10¢ now becomes a fixed——

"The WITNESS. Ceiling.

"The JUDGE. Ceiling.

"The WITNESS. That's right.

"The JUDGE. He cannot go above that ceiling once he submits to one company; he cannot go above that ceiling. He is hooked.

"The WITNESS. Under what we call the "favored nation clause," yes.

"The JUDGE. Well, whatever you call it, he is hooked for that amount.

"The WITNESS. That's right.

"The JUDGE. Thanks. (Tr. Vol. XXII, pp. 56–57)

The participants to the cross-licensing agreement have agreed upon a method whereby a third party wishing to do business with any participant must agree with his device may be considered by all of the participants through the Automobile Manufacturers Association.

In 1955, the cross-licensing agreement provided in pertinent part

"*Article VIII—Ideas submitted by persons other than parties*

"It is agreed that each idea relating to the subject matter of this Agreement submitted by a person other than a party to this Agreement shall be first submitted to one of said parties accompanied by a waiver in a form approved by the Patent Committee of the Automobile Manufacturers Association by which the submitter shall authorize such party to disclose the idea for appraisal and test to any third party or parties and grant immunity to said party as well as to all parties to whom such disclosure is made from all liability to the submitter arising from such disclosure other than such liability arising from the infringement of any valid patent covering the subject matter disclosed. Each such party shall then submit such ideas to the Vehicle Combustion Products Subcommittee for consideration, after which said Party shall report to the submitter the findings of said Subcommittee, and shall file a copy of said report with the secretary of said Subcommittee." (GJ Ex. 263).

This provision was amended in 1957 to read as follows:

"ARTICLE VIII—IDEAS AND INVENTIONS SUBMITTED BY PERSONS OTHER THAN PARTIES

"Nothing in this Agreement shall prevent any of the parties from receiving, considering or purchasing ideas or inventions submitted by others relating to the subject matter of this Agreement. In the event that such ideas or inventions are submitted to a party by a person other than a party to this Agreement or other than a person under contract to assign such ideas or inventions to a party, such party may submit such ideas or inventions to the Vehicle Combustion Products Subcommittee for consideration provided such party has obtained from the submitter a waiver in a form approved by the Patent Committee of the Automobile Manufacturers Association by which the submitter shall authorize such party to disclose the idea or invention for appraisal and test to any third party or parties and grant immunity to said party as well as to all parties to whom such disclosure is made from all liability to the submitter arising from such disclosure other than such liability arising from the infringement of any valid patent covering the subject matter disclosed. The said party shall thereafter report to the submitter the findings of said Subcommittee, and shall file a copy of said report with the secretary of said Subcommittee." (GJ Ex 264).

Mr Scherer testified as follows as to the substantive change worked by the 1957 amendment to Article VIII:

"A . . . it enables, as I understand it, to have each participating company consider ideas submitted by outside parties, not parties to the agreement, for consideration and test without the necessity of reporting that information to the (other) participant[s] under the cross-licensing agreement." (Tr Vol. XVII, pp. 44–46).

Plainly, Article VIII of the 1955 Agreement (GJ Ex 263) requires third parties dealing with any participant to agree to the submission of their device to the Vehicle Combustion Products Subcommittee of the Automobile Manufacturers Association.[5] As amended in the 1957 agreement (GJ Ex. 264), however, it would seem that referral to the VCP was no longer required. (Tr. Vol. XVII, pp. 44–46).

Mr. Van Derveer, however, testified unequivocally that it was communicated to him by both AMA and his superiors at American Motors that the signatories to the cross-licensing agreement had obligated themselves to insure that before any participant dealt with an independent device manufacturer that the device manufacturer must sign an AMA Suggestion Submission Agreement.[6] (Tr. Vol. XXXXVI, pp. 48–51; GJ Ex. 416). Even after the 1957 amendment, AMA continued to recommend to participants that an AMA Suggestion Submission Agreement be obtained from third parties (Tr. Vol. XVIII, p. 93).

Mr William K. Steinhagen, a General Motors engineer in charge of their Power Development Group, testified that when a third party came to him with a device, he was instructed to inform the third party of General Motor's obligations under the cross-licensing agreement and to obtain an agreement from the third party allowing tests of the device to be conducted under the terms of the cross-licensing agreement. (Tr. Vol. XXXII, p. 54).

Mr. Harold Lipchik, Vice President and General Manager of the Advanced Products Division, Chromalloy American Corporation, testified that in attempting to market the AMF–Chromalloy device to the automobile company participants in 1964, it was suggested by Mr. Chandler of the Ford Motor Company that the proper method of procedure would be for Lipchik to execute an AMA Suggestion Submission Agreement and to make his initial presentation to the AMA. (Tr. Vol. XVII, p. 59).

It is apparent from the foregoing testimony that the language change in the 1957 amendment worked no substantive change in the requirement that participants not consider third party devices unless an AMA Suggestion Submission Agreement was executed by the third party.

Minutes of the AMA Patent Committee meeting of May 13, 1959, read in part:

"The Committee reconfirmed the position taken at its September 22, 1955 meeting that it disapproved any meetings between industry members and persons who have not signed the Cross-Licensing Agreement unless the outsiders have executed an AMA Suggestion Submission Agreement and that there should be no exceptions to this policy." (GJ Ex 260).

That AMA highly regarded the method of dealing with third party devices is further illustrated by the following pertinent excerpt from GJ Exhibit 302, an unsigned memorandum dated April 20, 1965:

"Probably not for publication but Mr. Thornton (an AMA employee) says 1957 amendment was made because of antitrust problems in the first agreement. Changed the way people brought ideas to the committees from outsiders.

* * * * *

"Also not for publication—Mr. Thornton says the Patent Committee feels we should definitely renew—especially in view of the CID investigation. It would not be wise to discard the agreement at this time."

Mr Scherer's testimony on this amendment was as follows:

"Q. In other words, prior to the amendment in 1957, anybody who had signed the cross-licensing agreement was obligated, with respect to their dealings with outsiders, to submit any ideas which they received from outsiders to the Automobile Manufacturers Association Vehicle Combustion Products Committee? Isn't that correct?

"A That's correct.

"Q And it was felt in 1957 that there were some antitrust difficulties with that particular method of procedure, was there not?

"A All I can say to that is that on advice of counsel, it was changed." (Tr Vol. XVIII, pp 87–88).

Basically, there are three parts of an automobile emitting pollutants. One, the crankcase (blow-by); two, the carburetor and fuel tank (evaporation losses); and three, the exhaust. Before any devices were affixed to cars, the experts estimated that 25% of the pollutants were emitted from the crankcase, 15 to 25% from evaporation losses, and 50 to 60% from the exhaust.

In 1959 it was discovered at General Motors that a positive crankcase ventilation (pcv) valve, used even prior to World War II for the purpose of keeping the crankcase of military and other vehicles free of mud, sand, etc., was effective in the elimination of blow-by emissions from the crankcase (Tr. Vol. XXIX, p. 72; Tr. Vol. XXXVI, pp. 15–16). As a result, General Motors could have installed the device on its cars and obtained a competitive advantage since this type of device was not covered by the cross-licensing agreement. However, this was not done, but to the contrary, the cross-licensing agreement was amended in 1960 by the addition of five categories covering crankcase and evaporation losses so that the industry could act collectively with regard to these areas. (Tr. Vol. XXXVI, p. 15, GJ Ex. 265).

A July 27, 1959 memorandum from W P Sherman of the AMA staff to the EAC states in part:

"Mr. Delaney called attention to the fact that neither of these areas of investigation or development are covered by the present industry Cross-Licensing Agreement. It was, therefore, the unanimous recommendation of the committee and of Mr. Delaney that the Engineering Advisory Committee should immediately request the AMA Patent Committee to amend the Cross-Licensing Agreement to cover these areas, and to do so in the immediate future to permit the work to go forward rapidly." (GJ Ex 384).

An agreement was then made by the automobile manufacturers to install the pcv valve on all 1961 model cars to be delivered in California only. (Tr. Vol. XXXXIII, pp 99–100; GJ Ex 355, 445, 543). This was heralded as a "voluntary" contribution to the elimination of smog by the automobile industry. (Tr. Vol. XXI, pp. 15–17, GJ Ex. 355; Tr. Vol. XXIX, pp. 73–74). However, a document dated November 13, 1959 written by W S Berry of American Motors indicates the real motive for the installation of the device on 1961 models It reads in part as follows:

"There is time to complete our test work on this breather system before the introduction of the 1961 model. The reasons for making the announcement before test work is completed are as follows:

"1. The opportunity for the industry to voluntarily do something in California

Footnotes at end of article.

which will make a major reduction in emissions at a relatively low cost. In advancing this argument the AMA Staff uses a cost to the customer figure of around '$10'

"2 On December 4th there will be a hearing in Berkeley which will be held between the California State Department of Health to finalize recommendations on tailpipe emissions An announcement before that date would possibly slow down any regulatory action on this matter Likewise, this announcement may deter Governor Brown from holding a special session of the Legislature dealing with the air pollution problem.' (GJ Ex 888)

Quite evidently the cross-licensing agreement was not needed for protection or use of any patent As a matter of fact, no significant patents were then known to exist affecting development of pollution control devices and no lists of patents were then nor have they ever been annexed to the cross-licensing agreement or any extension thereof. (Tr Vol XXII, pp 84-85) It is submitted that the cross-licensing agreement was merely a vehicle to accomplish the non-competitive and delaying activities of the signatories thereto"

The evidence adduced before the Grand Jury clearly developed that the signatories to the cross-licensing agreement had the following understandings and agreements with respect to the installation of motor vehicle air pollution control devices (A) not to publicize competitively any solution to the motor vehicle air pollution problem; (B) to adopt a uniform date for announcement of the discovery of any air pollution control device, and (C) to install devices only on an agreed date (Tr. Vol. XXII, pp 49-50).

Minutes of the meeting of the Engineering Advisory Committee on January 10, 1958 read in part as follows

"The Committee report raised a number of questions for decision by EAC These were taken up in the following order

"(1) *Statement on exchange of information and publicity on smog research activity.* The VCP asked concurrence of EAC on this statement which was drafted in August by the VCP members Mr. Kucher stated that there is no misconception or objection to the objective the VCP has in mind, but he questioned what mechanism would be used; he suggested that specific provision be made for the submittal of plans for speeches and text ahead of time Mr. Heinen said that the VCP would include such ground rules with the statement.

"Mr Ackerman commented that there was no doubt about the EAC belief that such a program should be carried out on a cooperative basis. Mr Chayne moved approval of the proposal, with the instruction that it be sent to the company public relations directors, asking them to join in the effort to carry this out properly.

"The VCP report also called attention to the desirability of re-affirming the idea of a single announcement and a uniform adoption date for any device which the industry may decide to use for smog control Mr. Chayne moved that this view be included with the previous motion; EAC members approved" (GJ Ex 339; Tr Vol. XX. p. 78).

The following further excerpts from documents and testimony are illustrations of the understandings and agreements referred to above

A As to the agreement not to publicize competitively any solution to the problem:

"1 Grand Jury Exhibit 338, dated January 10, 1958, (Tr. Vol XX, p. 74), reads in part as follows.

" 'To a large degree, some of the questions in connection with the publication of data involved consideration of publicity effects which often result when some item of interest is released dealing with the smog problem The Committee believes that it was the intention of AMA in establishing the VCP activity to avoid situations in which competitive publicity advantages would arise and be seized by any one of the company participants *EAC re-affirmation of this viewpoint would be helpful*

• • • • •

" 'Similarly, there have been some fears expressed that technical developments in the air pollution program, which might happen to occur in one quarter rather than another, could lead to a situation in which some automobile companies might be more favorably positioned for the introduction of an exhaust control device than other companies Here it has been the VCP understanding from the beginning that the public service aspects of our cooperative work on the exhaust gas problem are such that no company should expect to take advantage competitively by being the first, or claiming to be the first, to offer such a device *It will be extremely helpful in the further conduct of our program if the EAC will take cognizance of the importance which is attached to this problem and re-affirm authoritatively that the companies will participate equally in the public relations benefits that will accrue from a single announcement in the uniform adoption date for any device which may be adopted for use*' "

The report of the EAC of the same date, January 10, 1958 shows that by vote it reaffirmed "the idea of a single announcement and a uniform adoption date for any device which the industry may decide to use for smog control." (GJ Ex 339)

"2 Grand Jury Exhibit 345, December 3, 1962 (Tr Vol XX, pp 105-106), reads in part as follows

" 'The Engineering Advisory Committee is in complete agreement with both the Public Relations Committee and the Vehicle Combustion Products Committee with regard to the need for more and better publicity about industry activities in the air pollution field

" 'The Engineering Advisory Committee does, however, share the concern of the Vehicle Combustion Products Committee regarding the dangers of ill-considered unilateral publicity The EAC recommends, therefore, that the proposal for increased publicity by the individual companies, as well as by the Automobile Manufacturers Association, be approved with the proviso that such releases concern only "activities" and that releases concerning specific "solutions" be issued by AMA

" 'It is essential that all releases be coordinated through AMA and that procedures be established to handle such coordination expeditiously.'

"3. Mr. Scherer's testimony on this subject was in part as follows (Tr. Vol. XX, pp 76-77):

" 'Q The matter of publicity, is it your understanding that by the terms of the cooperative arrangement in the industry with respect to motor vehicle air pollution control equipment, that no one company would advertise or publicize the merits of its equipment, vis-a-vis other companies in the field.

" 'A That was my understanding of their intention, yes.'

"4 An interdepartmental letter of American Motors dated November 28, 1962, reads in part as follows

" 'In the area of press releases there has been a tacit understanding, if not a written policy, that all individual company press releases will be reviewed by the AMA Public Relations Committee and the VCP. Ford has been the only flagrant violator of this policy, since on two occasions they have issued releases that caught the rest of the industry by surprise (announcement of vanadium pentoxide exhaust catalyst in 1957, and blowby control system in 1962).

" 'The current AMA Public Relations Committee recommendation to the Engineering Advisory Committee, which was initiated by G M is somewhat difficult to understand It has been suggested that it is a "veiled threat" to Chrysler because of that company's success (and related publicity) in making their cars meet the California standard for exhaust emissions without an exhaust treating device The proponents of this approach say that G M because of their overwhelming dominance in the field of smog research (see attached sheet for relative air pollution budgets of AMA member companies), are saying to Chrysler, "Slow down on this approach and don't break the industry front or we will completely submerge you, publicity-wise" ' (GJ Ex 842)

"5. Mr Van Derveer testified as follows concerning a 1957 publicity release by the Ford Motor Company (Tr Vol XXXXV pp 46, 51-53)

" 'Q So Ford issued a publicity statement on the vanadium pentoxide device, and it achieved nationwide recognition.

" 'A Yes.

Q And it was a device? A prototype device had been developed?

" 'A Yes

" 'Q Tested on cars

" 'A Yes Not very extensively, but, yes

" 'Q And then there was some unhappiness in the industry over Ford's publicity?

" 'A Correct.

" 'Q Now, who was the source of the unhappiness?

" 'A Well, Heinen was probably the most vocal on the thing

" 'Q All right What did Heinen say?

" 'A Well, he said lots of things, actually. But, more or less of a breach of a promise, the fact that this put Ford in a lot better light. And just the fact that the company was getting nation-wide attention for something, the other people were working equally hard on other things and they weren't getting any publicity. That sort of thing.

" 'Q Was there a little feeling that Ford was reaping too much advantage out of its publicity, and, therefore, Ford should not have issued the publicity statement?

" 'A. Well, that was certainly part of it.

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" 'Q So, there was an attempt to dampen the publicity that was issued a little while before

" 'A It wasn't actually a retraction, I guess.

" 'Q Not a retraction, but an attempt to dampen down the publicity.

" 'A. As I remember, yes

" 'Q What was the impetus of Ford to dampen down the publicity Was it because Heinen was disturbed about this?

" 'A. I am sure it was Heinen and General Motors being disturbed, too. I am sure General Motors had an opinion on it, I never heard it expressed particularly.' "

B. As to the agreement for the adoption of a uniform date for announcement of the discovery of a device

"1. In an interoffice memorandum from R. J Templin, Cadillac Motor Car Division, to J. H Lamb, also of GM, dated October 6, 1959, Mr. Templin stated

" 'Please note that we are bound by an agreement through Mr C A Chayne with the Automobile Manufacturers Association to withhold any public knowledge about these devices until a joint industry announcement can be made through AMA These devices must, therefore, be treated as confidential.' (GJ Ex 499)

"2 Mr Scherer's testimony on this point was in part as follows (Tr. Vol. XXII, pp. 49-50):

" 'Q Have they also had the understanding to adopt a uniform date for the announcement of the discovery of any air pollution control device?

Footnotes at end of article.

"'A I would say that's the way the program has operated, yes

"3 Mr Scherer further testified (Tr Vol XX, pp 75-76)

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"'Now, that's a fact, isn't it, that the industry, from that point on [Jan 10, 1958], has publicized a uniform adoption date for any device that is produced in this field?

"A You are asking me?

"'Q Yes, I am asking you

"'A That's correct There is one thing to be said for that type of thing Remember that there were some of the participants in the program who may not have been quite ready to go ahead with the adoption of the device as far as their own testing and knowledge is concerned They were pressed into going ahead with it, much ahead, perhaps, of the time that they were ready

"'Yes, and if they weren't ready, they may also have waited until—

"'A If they were ready?

"'Q. The others could wait——

"'A That's possible

"'Q —until the device was ready until everybody could put it on at the same time?

"'A. That's possible So, it works both ways.

"'Q. But, there is no doubt about it that the policy has been consistent and that it is right up to this date, that no device has been adopted by any one company on its own; that they all did it at a uniform adoption date; they all put it on at the same time? Is that correct, sir?

"'A I believe that's correct.'"

C. As to the agreement to install devices only on an agreed date:

"1. Testimony by Mr. Scherer on this subject was in part as follows (Tr. Vol. XXI, p. 33):

"'Q Is this kind of behavior on the part of the individual companies the result of an agreement among all of them to adopt devices at a uniform date, and that one company would not go ahead with the device unless all of the other companies were in the position to go ahead with the device?

"'A. We did note in the record that there was such an understanding among the companies, yes."

"2. Minutes of the EAC meeting, dated May 17, 1962, read in part as follows:

"'UNIFORM ADOPTION AND ANNOUNCEMENT OF SOLUTIONS

"'At this point Mr. Caplan read the rest of his report and raised for discussion the problems that had arisen as a result of publicity and the supplying of some equipment for engine modification to Los Angeles County officials prior to its being supplied to the State Board This had resulted in a letter from the County Board of Supervisors, which has been acknowledged but not yet answered, urging AMA action by all of the automobile companies to engage in a similar modification program Mr. Isbrandt suggested that the handling of these problems required simply that all of the participants be cognizant of the responsibilities already outlined and understood in the EAC and VCP activity'" (Memorandum Report, EAC Meeting, dated May 17, 1962; GJ Ex 379).

Thus we have seen that the non-competitive industry program was not limited to research and development but encompassed promotion, installation, and marketing. On this score Mr. Van Derveer testified (Tr. Vol. XXXXVI, pp. 54-56):

"Q Mr. Van Derveer, this non-competitive industry program concerned not only the research and development but also the installation and marketing of devices, did it not?

"A Well, what do you mean by devices? You are talking about——

"Q. Devices or systems, any kind of motor vehicle air pollution control equipment whatsoever.

"A It was all coordinated through the AMA, yes.

"Q All aspects of any company activity in this area?

"A Yes"

POSITIVE CRANKCASE DEVICE (BLOW-BY)

A GM document disclosed that the AMA asked all car manufacturers on June 1, 1961, to give all the reasons that could be developed as to why compliance with a Congressional request that positive crankcase ventilation (pcv) be made standard equipment on all cars would not be desirable "It must be recognized that they are specifically looking for problems that will justify a negative decision," commented G. R Fitzgerald, a GM engineer (GJ Ex. 504) After the successful installation of the pcv valve in California by all companies on 1961 models, a decision was made not to install the device on all 1962 models nationally. Mr. Van Derveer testified that "the board of directors, of course, are the ones that had to make that decision." (Tr Vol. XXXXV, pp. 71-76.) A poll or vote was taken at a meeting of the AMA Crankcase Ventilation Task Group of the VCP on January 26,, 1961. (GJ Ex. 360 and 442.) Although Studebaker-Packard and American Motors "agreed to the release of positive crankcase ventilation for all 1962 cars," none of the companies did so, in accordance with the industry agreement.[6] (Tr. Vol. XXI, pp. 32-33; Tr. Vol. XXII, pp. 49-50; Tr Vol. XXIX, pp. 107-110, 130-133; GJ Ex. 360 and 442.)

All GM divisions could have supplied the internal crankcase device as standard equipment for 1962, if required to do so. H F Barr, then Chief Engineer of Chevrolet, writing to C. A. Chayne, then Engineering V P. of GM, said in part:

"Would all GM Divisions be in a position to supply internal crankcase ventilation as standard equipment for 1962 production?

"(Answer) We could if it was a mandatory GM policy, but we would not willingly do so." (GJ Ex. 474).

Similarly, in a memorandum of the Ford Motor Company dated January 10, 1961, James M. Chandler wrote:

"I have recently checked with John Asselstine of Engine and Foundry regarding engineering release of positive crankcase ventilation devices for nation-wide application. Mr. Asselstine informs me that inasmuch as those devices have been released, nation wide, as a regular production option for 1961 automobiles he sees no reason why they could not be applied on all production in 1962. He also feels that we would be in a position to release the crankcase device nation-wide on all commercial vehicles for 1962." (GJ Ex. 454).

As far as International Harvester was concerned, a September 26, 1961 letter from S. G. Johnson of International Harvester to W. F Sherman of AMA states in pertinent part

"II. International Harvester is in position to comply with blowby devices on all motor truck models at any date deemed advisable by AMA. (GJ Ex. 364).

As a matter of fact, the device could have been installed on 1961 models:

"The main reason that the motor vehicle industry did not voluntarily undertake to supply internal venting throughout the country on all its new gasoline-powered vehicles, starting with the 1961 models, was that a need had been established in California which has not been established elsewhere. "(Rough Draft of paper presented at ECS-APCA Meeting, by James M Chandler, Chairman, VCP-AMA, entitled "Current Status and Future Work on Vehicle Emission Control Devices," undated (GJ Ex 361)).

As a result of this thinking, an interdepartmental letter of American Motors from its VCP member, Ralph H. Isbrandt, dated December 7, 1961, indicates that the AMA Board of Directors as early as December, 1961 determined and agreed that the device should be installed not one year later, in 1962, but two years later, in 1963:

"At the AMA Board of Directors meeting, held December 6, 1961, it was agreed that the industry would include Positive Crankcase Ventilation devices as standard equipment on all 1963 model cars." (GJ Ex 556)

An attempt was even made to delay national installation on 1963 models (Tr Vol XXX, pp 27 32; GJ Ex 373) Robert J. Templin, Asst Chief Engineer, Cadillac Motor Car Division, G M wrote on September 25, 1961, "To sum it up, there is nothing to prevent our going to positive crankcase ventilation as standard equipment for 1963, if policy dictates it Our lives will be less troubled, however, if we don't do it." (Tr Vol. XXXVII, p 7; GJ Ex 509). This time, however, the pressure of public officials forced the issue A memorandum by W P. Sherman of AMA to the EAC, dated May 25, 1961 reads in part as follows:

"The U.S. automobile industry has been asked to help protect the public health by installing 'on your own initiative' a device in all new cars which destroys crankcase fumes.

"Sen. Maurine Neuberger, (D Org) made the request in a letter sent Monday to 14 manufacturers of cars and trucks. She suggested that in the event the automobile industry failed to seize the initiative, it would be subject to 'responsible legislation to prohibit the transportation in interstate commerce of vehicles without the protective device.'

"Sen. Neuberger noted that the Automobile Manufacturers Association had rejected a request by the Secretary of Health, Education and Welfare that the industry install at the factory a device which destroys crankcase fumes, a factor in air pollution along with auto exhaust fumes." (GJ Ex. 365).

A similar memorandum for use by Mr Sherman at the EAC meeting of May 25, 1961, also reads in part as follows:

"Since all of the companies are presumably receiving a letter from Sen. Neuberger, I have a specific suggestion to make. First, I would suggest that as in the recent past with similar letters, be referred to AMA for a reply.

• • • • •

"Three, I believe it is very much in the interest of the industry to take the initiative before it is pushed further on this matter and that the Engineering Advisory Committee should therefore recommend to the Board of Directors at their meeting on June 15 that a public statement be issued saying that inasmuch as service experience has proved to be at least reasonably satisfactory, it is being recommended to all member companies that as their tooling and manufacturing permits, they proceed to apply the device to all vehicles for sale in all parts of the United States.

"If this action is not taken by the industry, it seems certain that there will be Federal legislation.

"It also seems to me that the opportunity provided in this instance to make a very big distinction between these inexpensive devices and exhaust control devices for use in California, which are more expensive and which are applicable primarily to the photochemical smog problem, might be utilized to position the industry for the future, although we certainly can't ignore the possibility that similar pressures will arise with regard to any muffler devices that are adopted at a later date in California" (GJ Ex 366)

As a result of this pressure, the attempt to delay installation of the device until at least 1964 failed, and the companies agreed and did install the pcv valve on all 1963 models nationally. (Tr. Vol. XXXXV, pp

Footnotes at end of article

24 25) The same valve that was installed on all 1961 models in California was used nationally on 1963 models, indicating that bar the industry agreement, the device could certainly have been installed nationally at least on 1962 models. (Tr. Vol. XXXXIII, pp 101–102).

CLOSED CRANKCASE DEVICE

After the installation of the pcv valve, it was discovered that the slight remaining emission of pollutants from the crankcase could be eliminated by piping it into the air cleaner where it would be completely dissipated As a result the Motor Vehicle Pollution Control Board (MVPCB) of California adopted an amended test procedure on December 18, 1962 which could only be met by the installation of the closed type system New York State officials, too, wanted a closed system The EAC reviewed both the California and New York situations and reached the conclusion on March 1, 1963 "that the industry definitely does not want to be forced into putting the new systems [closed blow-by] on New York cars for 1963 and 1964" (Tr Vol XXXVI, p 151) Since it seemed doubtful that New York would accept less than California for a crankcase device performance, the EAC decided that California was the place to take a firm stand against the new higher capacity systems. To enforce their position, the EAC asked each member company to provide technical information to show why it was impractical to install high-capacity devices for the years 1963 and 1964 (OJ Ex 507) The Committee was delegated by Mr. Chayne, GM's vice president in charge of engineering, to prepare a specific list of technical problems which might prevent General Motors Car Divisions from supplying crankcase ventilation systems on the 1964 models which would meet the new high flow requirements and still be reliable in all respects. (Tr. Vol. XXXVI, pp 149152, OJ Ex 507) (Cf. OJ Ex 457, a Ford document, which reads in part "In March we told California we . . . questioned our read)ness for closed systems Early application for certification [by Chrysler] would cast doubt"

In an interoffice memo, H F Barr, GM's member on the EAC, on March 28, 1963, wrote in part

"I have recently had a call from Mr Paul Ackerman of Chrysler which indicates they are pulling back their 1964 start of production releases and will release later, effective January 1, 1964, if required at that time by the California law We are, of course, all hopeful that this will be further extended to start of production of 1965 models before time for this action arrives.

"It is therefore quite important that no General Motors Division make any changes in their 1963 releases for start of 1964 model year production. Since changes would jeopardize the industry position that is being taken with the Air Pollution Board of California" (OJ Ex 478)

In an intra company memo, Robert Sorenson of Chrysler informed P C Ackerman, its EAC member on January 11, 1963 in part as follows

"Attached is a letter received from Ben Jensen Executive Officer, California Motor Vehicle Pollution Control Board officially advising us of the action of December 18, 1962 meeting of the board His letter indicates that two closed crankcase system devices were approved for both factory and used vehicles

* * * * *

"AMA staff was not favorable to an immediate approach and Harry Williams has taken the matter over personally. I understand that he will discuss it with some of the California Motor Vhicle Pollution Control Board members at a pre-established meeting early in February.

"Because of Chrysler's commitment to handle this on an industry basis, there appears to be nothing further we can do on this matter at this time on a Chrysler only basis" (OJ Ex 446).

In an interdepartmental letter from Van Derveer to Isbrandt, also American Motors EAC member, dated April 29, 1963, American Motors' position is stated as follows

"It is the writer's and C Harbes's opinion that for our 1964 production we have no other choice but to comply with New York's criteria by either the procedure just outlined or by installing the 'closed' system hardware that is released for California production commencing January 2, 1964 However, if we release the '64 California 'fis' for car one 1964 New York State production, we will run afoul of the A.M.A policy on this matter, and as you are aware various industry representatives feel quite strongly that industry solidarity is a must on this matter" (OJ Ex 558).

However, the industry's attempt to delay the installation of the closed blow-by device to the start of production of 1965 models failed since the MVPCB forced the installation of the closed blow-by system as of January 1, 1964 (Tr. Vol. XXI, pp 68–73; Tr Vol. XXXVI, pp 155–157, OJ Ex 508). AMA's position at the meting of the MVPCB, in regard to this matter, is indicated in the following GM interoffice memo dated January 24 1963, as follows

"At the December meeting, the Board decided to require 'closed' type crankcase devices on new cars beginning with the 1964 model year George Delaney, representing the AMA, strongly objected to the Boards' action. According to reports. Delaney claimed that the manufacturers had already firmed their 1964 designs and changes could not be made to meet the deadline.

"According to rumors, the AMA was so incensed at the Board's action, they resolved to boycott future meetings, and since the AMA was not represented at the January 17 meeting, a proposal was adopted which may be costly to the industry. Of course, the action might have been taken whether or not the AMA was represented, but the Board didn't even have the benefit of hearing the industry's objections. (OJ Ex 375).

As to the ability of the auto companies to install a closed blow-by system on their cars, our expert, Wallace Linville, testified:

"Q Is there any reason why that couldn't have been done by the industry prior to 1964?

"A No It is similar to a system that you find and have found for years on particularly dump trucks where they are operating in very dirty areas, and again on the army equipment that we mentioned in the second World War, where they are running in convoy, the vehicles following the first vehicle are operating in very dusty terrain, and as a result of this they have had the system closed by means of this tube to the air cleaner for a good number of years, so I see no reason why this should have offered a substantial or major problem at all." (Tr. Vol XXXXI, p 25)

Errol J Gay, a consultant for TRW and others, and an apologist for the auto industry, when asked the same question testified

"A Hell, they could have done it prior to 1938, if necessary" (Tr Vol LVII, p 73)

EXHAUST DEVICES

By California statute passed in December, 1959, all automobile manufacturers were required within one year following certification of any two motor vehicle air pollution control devices to affix an air pollution control device on all cars sold

Chrysler Corporation developed its Cleaner Air Package (CAP) perhaps as early as 1960. (Tr Vol XXIX, pp 18–19, 30). In a memo dated October 5, 1961, D R Diggs of E I Du Pont, reported

"I asked Heinen why Chrysler did not seek California certification of their vehicles without devices if they are as good as he says they can be made While admitting that favorable publicity would result, he was very forceful in telling me that if this was done Chrysler would be severely chastised by the rest of the industry He reminded me that the AMA agreement says no one company will gain any competitive advantage because of smog, and that Chrysler was a relatively small cog in the industry He indicated Ford and GM were calling the shots and implied that Chayne was the industry mastermind" (OJ Ex 183)

The CAP system consisted of a valve (part of which was patented) and adjustments of the carburetor, distributor and spark timing Several technical papers on the subject were written by Chrysler employees, Heinen and Fagley, and published by SAE (Tr Vol XXX, pp. 108, 120–23) Despite an understanding among AMA members to deal only with the California Motor Vehicle Pollution Control Board and not with the Los Angeles Pollution Control District and its then executive officer, S. Smith Griswold, Mr. Heinen dealt with Mr Griswold, applied for state certification of the CAP, installed the device on 100 cars as a test, and agreed to fulfill specifications contained in Los Angeles County car purchasing invitations for devices which would control exhaust pollution to the extent of emitting no more than 300 ppm of hydrocarbons and 1.5% of carbon monoxide (Tr Vol. XXIX, p. 119)

In early 1964, Chrysler began to deliver cars to the County of Los Angeles with the CAP system affixed All told about 1,000 cars were delivered in 1964 with that system (Tr Vol XXIX, p. 120) The fact that Chrysler got the order to supply cars for Los Angeles County in 1964 was resented by the rest of the industry as a breach of the industry agreement and great effort was made to bring Chrysler back into the fold, which was successful as will be hereinafter shown (Tr Vol. XXX, pp. 130, 140–41; OJ Ex 183, 226) The result of Chrysler's action in supplying 1964 cars to the county resulted in Ford, too, offering cars equipped with an exhaust device to the county in 1965 which controlled emissions to the required degree.[9]

By the end of 1963 and early in 1964, it was quite apparent that the California Motor Vehicle Pollution Control Board (which required that emissions be limited to 275 ppm of hydrocarbons and 1½% CO) would certify at least two devices being produced by independent (not automobile) manufacturers thereby triggering the law and compelling the installation of air pollution exhaust control devices on all 1966 models offered for sale in California in late 1965. (Tr. Vol XXXVII, pp. 33–37; OJ Ex. 402)

Every effort was thereupon made by the industry members of AMA to delay the installation of such devices at least until 1967 (OJ Ex 339, 405) A memorandum dated March 9, 1964, from William Sherman of the AMA staff (Secretary-EAC Committee) to his superior Mr Harry Williams, Managing Director of the AMA, reads in part

"While we certainly have the objective of holding the line until 1967 models, we know that the stated purpose of the California MVPCB is to approve two catalytic devices in the next few months and trigger the law so it will apply to 1966 models

"It seems to me that we would be exercising vary poor judgment if we suggested or implied that we wanted them to hold off the triggering of the law, or to let ourselves get into any controversial position about it

"*If they* do act in the near future to approve the catalytic devices, our companies would probably have to take the position, *anyhow*, that there is not enough engineering time to fit the catalytic converters under the frames and chassis of cars in time to meet the schedule of 1966 model production and there would be a strong likelihood of various delays until 1967 introductions.

Footnotes at end of article.

"It would be very much to our advantage to avoid this topic—shrug it off or ignore it for a month or two In the interim a lot of things might change in the picture, including even the withdrawal of the catalytic devices now on tests when the submitters analyze the future possibilities for themselves

"Thus the problem will have some tendency 'to go away' if we don't aggravate discussion of it at this time " (GJ Ex 402, Tr Vol XXII, pp. 14-15)

On March 10, 1964, prior to any certification of third party devices by the MVPCB but in anticipation that such certification was imminent, the AMA issued a carefully worded press release announcing "that member companies have set a target date of the fall of 1966 in their programs to make 1967 model automobiles and passenger car-like trucks for sale in California comply with the state's motor vehicle emissions standards" (GJ Ex 407).

The EAC at a meeting on January 17, 1964, had adopted the following resolution

"Members of the Engineering Advisory Committee resolve that as engineering representatives of the member companies of AMA they adopt the goal that starting with 1967 models, all Amerian-built passenger cars and passenger car-like trucks to be sold in California meet the California Exhaust Standard of 275 ppm hydrocarbon and 1½ per cent CO; further, the Engineering Advisory Committee will report to the AMA Board of Directors their intention to proceed with product engineering programs on each of the various engine and transmission combinations and, by January, 1965, further report to the Board of Directors whether necessary changes can be made in time to meet the target date, the beginning of 1967 model production.' (GJ Ex. 399; Tr. Vol. XXX, pp. 72-73).

Pursuant to this EAC resolution, the AMA Board of Directors at a meeting on February 26, 1964, accepted the EAC recommendation, and on motion recommended to all companies that they make it the basis for their individual action. (Tr. Vol. XXX, pp. 71-72; GJ Ex. 405). Subsequently, the March 10 press release was issued. At a joint meeting of the AMA Public Relations Committee and the EAC on March 3, 1964, the reasons for the selection of the March 10 date for the press release were given:

"[Mr. Misch, the representative of the Ford Motor Company to the EAC and also its (EAC's) chairman] advised . . that the Board had discussed the timing of a press release and desired that such a press release should be made on March 10, before the State Motor Vehicle Pollution Control Board meets on the 11th, but that the industry plan should be reported to the Governor and officials of the Motor Vehicle Pollution Control Board before release is made." (GJ Ex 401).

The lack of sincerity of the EAC resolution is shown by the fact that the references to product engineering indicated that such engineering had not yet begun. Actually, the Chrysler CAP had already been factory produced on 1964 cars for Los Angeles County. The GM ManAirOx system, the Ford Thermactor system, and the American Motors Air-Guard system, whereby in each the exhaust is burned in the exhaust manifold with the addition of air from an air pump, were then sufficiently ready for production (except for the pump) so that when compelled to do so later in 1964, both GM and Ford announced their ability to apply the device on 1966 models. (GJ Ex 410) As for the pump, a crash program commenced at GM early in 1964 produced the Saginaw pump within five or six months (Tr Vol. XXXVII, pp. 32, 42).

As a matter of fact Ford was preparing for Job 1, 1966 with its Thermactor system while adhering to the AMA attempt to delay installation of any exhaust device at least another year A Ford confidential internal memorandum dated June 26, 1964 reads in part

"It became apparent that the Board was positioning itself to approve two or more exhaust treating devices in mid 1964 so that 1966 models would need to be equipped with exhaust treating devices.

"In light of these actions, the automobile industry through the A M A reviewed its position relative to the California situation. On March 10, 1964, the A M A board of Directors announced that it had adopted a goal of Job 1, 1967 for supplying passenger cars and passenger car-like trucks to California which would meet California's exhaust requirements. At the same time, the Executive Office directed that the Company be prepared to meet the California exhaust requirements by Job 1, 1966

* * * * *

"It should be recognized that our external program as presented to California is to meet Job 1, 1967, but that our internal program is to meet Job 1, 1966. It is recommended that the 1967 goal remain our public posture." (GJ Ex. 599)

Apparently GM and Ford would have continued their opposition to the installation on 1966 Models of an exhaust device or system, but the possibility of Chrysler's application being granted for certification of its Cleaner Air Package thwarted their hopes:

"There is one disturbing element as far as GM and Ford are concerned in the position they have taken. This is the fact that Chrysler *may* receive certification in California for their Clean Air Package; if so it is doubtful if Ford and GM can delay until 1967 the installation of comparable systems." (Memorandum Report by D R Diggs, E. I. Du Pont, dated July 6, 1964. GJ Ex. 190).

FURTHER DELAYING TACTICS

The collective activities of the automobile manufacturers to delay the marketing and application of air pollution exhaust control devices and not to take competitive advantage of each other is illustrated by the following instances:

(1) Since the industry was fortified from the beginning of the program with the agreement among its members not to take competitive advantage over each other, all auto manufacturers were able through the years to stall, delay, impede and retard research, development, production and installation of motor vehicle air pollution control equipment.

As early as January 20, 1959 the Scientific Director of General Motors, Mr J. M. Campbell, complained to Dr. J. M. Hafsted, the head of GM's scientific laboratory that "Our effort thus far has been at a minimal level required to cover essential areas of this problem while at the same time protecting other essential research programs at current levels." (Tr. Vol. XXXXV, p. 23; GJ Ex. 492).

On September 10, 1962 Dr. Hafsted expressed his concern in similar vein in writing to Mr L. C. Goad, an executive vice president of GM, as follows: "It is my conviction that this problem needs more attention than it has been getting all along the line in our engine development programs" (Tr Vol. XXXXV, p. 26; GJ Ex. 493).

A letter dated January 27, 1964 written by Mr. Howard Dietrich, of the Rochester Products Division of GM, to one K. F. Lingg, states that "Mr. Gordon [then the President of GM] feels, and has publicly stated, that anti-air pollution vehicle developments are 'agonizingly slow'" (Tr Vol. XXXXV, pp. 34-35; GJ Ex. 494).

Dr Donald Diggs, Asst. Technical Manager of the Petroleum chemical division, Du Pont Corporation, one of the witnesses before the Grand Jury, wrote several reports evaluating the attitude of the automobile industry towards the development of curative smog devices, such as that of April 21, 1959 which contains the following statement

"They [referring to the big three automobile manufacturers] are not . . interested in making or selling devices . . but are working solely to protect themselves against poor public relations and the time when exhaust control devices may be required by law" (GJ Ex 162; Tr Vol XLV, pp. 29-30).

Dr. Diggs also wrote a report dated May 31, 1962 in which he gave the following cogent description of the industry's attitude

"Therefore, they cannot justify an extensive research program because the competition might devise a solution which, while perhaps not as effective, would be less costly to the motorist. The only incentive is to just barely solve the problem at the minimum cost. For that reason, each company is reluctant to spend large amounts of their own money for the development of cures" (GJ Ex 186)

Dr. Diggs testified that he felt the industry could have pushed more rapidly than it did toward a solution of the smog abatement problem, inasmuch as their work was conducted "at rather low levels of activity" (GJ Ex 198; Tr Vol. XIV, pp. 155-156).

An official of the Maremont Automotive Products Company volunteered a statement to officials of the Du Pont Corporation which is contained in a report dated May 19, 1960 which confirmed Du Pont's thinking in regard to the automobile manufacturers that they "were keeping up a good front, but were not pushing as rapidly as they could toward a solution of the smog abatement problem." (GJ Ex. 196).

As a matter of fact, one of the functions of the AMA smog working group, according to Mr. James Chandler of the Ford Motor Company, was to "contain" the smog problem. Mr. Chandler was of the view as of May 21, 1959 that the problem "is not bad enough to warrant the enormous cost and administrative problems of installing three-million afterburners." (GJ Ex. 418).

J. D. Ullman, another technical expert in the petroleum chemical division of the Du Pont Corporation also wrote reports on the dilatory approach of the automobile companies toward smog control measures which contain the following statements:

"The automotive industry as a whole has taken a very firm position in relation to the California authorities. Basically, the automotive manufacturers would seek to avoid installing a reactor of any sort on a car because it adds cost, but provides no customer benefits such as improved engine performance or styling advances [As a result] A smog abatement device will be installed on cars for California market only after being approved and requested by the Government of California." (GJ Ex 194 dated January 19, 1960).

"We gathered that the automobile industry will continue to do whatever it can within the scope of California legislation and of political pressure to postpone installation of exhaust control devices. The crank case vent will be pointed to as a constructive step by the automobile industry and will be given as much credit as possible for reducing hydrocarbon emissions from the automobile" (GJ Ex. 195, dated April 22, 1960).

(2) The air injection system developed by General Motors was fully described in a paper read before the Society of American Engineers on March 12-16, 1962, entitled, "A Progress Report on ManAirOx-Manifold Air Oxidation of Exhaust Gas" (GJ Ex. 282), but it was not installed on GM cars until all of the automobile companies simultaneously announced antismog systems for all 1966 California models.

(3) As early as 1958 Charles Heinen, the engineer in charge of the air pollution control program at Chrysler, and his assistant,

Walter S Pagley, Jr coauthored a paper entitled, "Maintenance and the Automobile Exhaust." (Tr Vol XXX, p 106) A second report followed in May, 1962 (Tr Vol XXX, p 120) This paper was omitted from an SAE book entitled, "Vehicle Emissions" published in 1964 which purported to contain an anthology of all SAE papers of significant contribution to the air pollution problem (Tr Vol XXX, p 123, Tr Vol XXX, p 91) Evidently the omission was influenced by Heinen's desire to equip all cars sold in California in 1962 with the CAP (Tr Vol XXX, pp. 132 136, OJ Ex 448)

Moreover, when Chrysler decided to submit their Cleaner Air Package to the California MVPCB in October, 1963 for certification "the rest of the industry felt that this was a breach on the part of Chrysler of the Automobile Manufacturers Agreement [which] specified that all manufacturers would work together as an industry rather than as individual companies The final straw came when after Chrysler had submitted their Clean Air Package to the Board the County government decided that wherever possible they would buy only Chrysler vehicles This, they stated, was to show their appreciation of the attempts by Chrysler to develop a smog-free automobile" (Tr Vol XXX, pp 140–141, OJ Ex 236)

Despite the success of the CAP, in 1964 Chrysler showed that it came back into line by joining in the aforementioned resolution calling for product engineering and delay of installation until the 1967 models, and by not equipping its cars with the CAP system until installed by all manufacturers on 1966 models to be sold in California (Tr Vol XXIX, pp 121 122) Chrysler's concern that the industry cooperative smog program be kept intact is clearly evident from a report by R A Pittman of the Ford Motor Company concerning a meeting with Bob Sorenson of Chrysler, dated February 6, 1964

"NOTES ON MY DISCUSSION WITH BOB SORENSON CONCERNING 'SMOG'

"B Chrysler management is sorry that things have progressed to the extent they have in Los Angeles County and they have been trying to determine how they can back off of what's been said already to Los Angeles County

• • • • •

"D Bob again emphasized that his company wanted nothing but a cooperative effort and would entertain any other suggestions as to how to get back on a cooperative basis" (OJ Ex 461)

A handwritten note on this document written by Arjay Miller, President of Ford, dated February 18, 1964 reads as follows

"I think Chrysler is playing us as suckers They get all of the favorable publicity and the car sales, while giving up nothing" (OJ Ex 461)

Despite the pressure of the industry, on March 13, 1964 the MVPCB notified each automobile manufacturer that the Board was then testing four exhaust control devices on an accelerated basis, two of which if certified would automatically trigger the mandatory aspects of the law requiring 1966 models to meet the standards In a letter to Mr John F Gordon, then President of AMA, Dr J B Askew, Chairman of the MVPCB, stated that he was hopeful the industry would "reevaluate your policy decision and work with us to achieve exhaust controls for 1966 models" (Tr Vol XXX pp 98 99, OJ Ex 447)

On June 17, 1964 formal approval was given by the MVPCB of California to four devices manufactured by independent concerns outside of the automobile industry Thereafter, on July 7, 1964, in response to a MVPCB request that the individual car manufacturers present their plans with respect to meeting the California standards for 1966 models required by the certification of outside devices, the automobile companies declared their intention to apply air injection systems (General Motors, Ford and American Motors) and an engine modification system (Chrysler) for 1966 cars sold in the State of California (OJ Ex 419) This determination was formally announced by the industry at a presentation made to the MVPCB on August 12, 1964 The pressure of events, therefore, compelled the car manufacturers to advance the application date of exhaust devices at least a full year in advance of their resolved plans and then only to meet the requirements of law.

The Chrysler Corporation could actually have installed the CAP on their 1965 model automobiles according to a report of Mr J E Yingst of the TRW Corporation dated June 24 1964, which reads in pertinent part as follows

"During the last month I have met at the four major automobile corporations with the staff and research level engineering people who are responsible for the exhaust emissions control programs in their respective corporations These meetings were in conjunction with the presentations of the Texaco TRW work on a catalytic control system and in response to the interest on the part of Ford, American Motors and General Motors in our air pump

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"(4) Chrysler stated without reservation that they have now engineered their combustion control system into all of their car models and could, if required, offer the system on even their 1965 cars" (OJ Ex 420)

EVAPORATION LOSSES

As early as June 1958, J. T Wentworth, a member of the GM research staff prepared a technical paper on the subject of "Carburetor Evaporation Losses" which was published in a compilation of technical papers presented under the auspices of the SAE. This paper was first discussed at a meeting of the Induction System Task Group held on January 14, 1958 (Tr Vol XXI, pp. 96-97, OJ Ex 280) Wentworth's tests were analyzed in his paper and the results showed that evaporation losses of unburned hydrocarbons were as great as those normally emitted from the tailpipe (Tr. Vol XXI, p 98)

On September 18, 1961 a GM engineer named H H Dietrich obtained a patent on a method to control evaporation losses which was assigned to General Motors His application for this patent was filed on August 6, 1960 General Motors thus knew of the Dietrich system and the art involved in its invention as early as 1960 (Tr Vol V, p 35, OJ Ex 82)

It should be noted that twenty different papers were written on this subject from 1958 to 1964 (Tr Vol XXI, p 123) A report entitled "Fuel System Evaporation Losses" was issued by the AMA in September, 1961 (Tr Vol XXI, p. 113) Clearance for release of this report to the California authorities by the member companies of AMA was not given until March 3, 1965, because as Mr Linville testified:

"It would seem fairly reasonable that this report would have triggered a great deal of comment and a great deal of criticism of the industry when there were certain cars over 2000 percent higher than other cars, so it seemed that this could easily have been the reason that this report was kept internal and not allowed to be read by outsiders until modifications could have been made to bring these high emitters down more nearly in line with the low emitters" Vol XXI pp 114 118, OJ Ex 391 (d) Tr Vol XXXXI, p 37 Cf Memo report of VCP Committee meeting held on Sept 16 1960, OJ Ex 281, p 1)

The cross-licensing agreement was amended in 1960 to include fuel system evaporation losses and Ford and Studebaker began a study of this problem in that year. (Tr Vol XXI, pp 100 101, 106) Dr Norman Alpert, Assistant Director of Research at the Esso Corporation testified that if something had then been done to control evaporation losses it would have been equally as important as the elimination of blow-by emissions (Tr Vol V, p 13) Most members of the Induction System Task Group were of the opinion that carburetor evaporation running losses could be eliminated in March 1961 (Tr Vol. XXI, p 111, Tr Vol XXX p 155, OJ Ex 389) Yet the minutes of the Fuel System Emission Task Group of the VCP disclose that as of October 15 1963 "relatively little is being done by the individual companies on vapor loss control" Tr Vol XXI, p 113, OJ Ex 390)

In June, 1959 Union Oil Co developed a system to eliminate evaporation losses but although tested by the industry through AMA it was ignored (Tr Vol IV pp 19 36 43 46, OJ Ex 52 and 54) Even to date the auto manufacturers maintain that there is no practical, economic or feasible system to control evaporation losses, although a Ford, a Chrysler, and a GM car were equipped with a charcoal filter developed by the Esso Corporation to control such losses, Esso having furnished each of these companies with a car of its own manufacture equipped with the device on April 4, 1966 (Tr Vol XXI, pp 125–127; OJ Ex 393, 395). Dr John Gerrard, project engineer for the Esso Research and Engineering Company, Linden, New Jersey testified that the Esso Corporation system (which controls better than 95 percent of such losses), was successfully tested on these cars. (Tr Vol V, p. 19, Tr Vol. VI, p 5) The response of the automobile industry to the Esso system, known as the ELCD system, ranged from hostile to "spotty," although all except Ford are still testing the system and they agree, in general, with the results obtained by Esso. (Tr. Vol. VI, pp 38–33, Tr. Vol. V, pp. 31–33) This system involves no major engineering change in the motor despite assertions to the contrary by industry spokesmen. All that is required are minor carburetor modifications and a tube which runs from the gas tank vent to a canister filled with charcoal which acts as a filter for the polluting emissions (Tr Vol VI, pp. 51–55).

The estimated cost of the system as original equipment would run from $5 to $7, but in great volume it would come down from this figure (Tr Vol. V, p. 27)

On September 23, 1964, more than six years after publication of the Wentworth paper and three years after issuance of the Dietrich patent, GM concluded that "It is necessary for us to begin development programs on devices to control these [evaporation loss] emissions" This action was taken only after the California Air Pollution authorities had advised they would take steps in October, 1964 to require evaporation loss limits on fuel tanks and carburetors (Tr Vol XXXVII, p. 93; OJ Ex 953)

OXIDES OF NITROGEN

Oxides of nitrogen (NOx) is a recognized pollutant emitted from the automobile exhaust together with hydrocarbons and carbon monoxide This noxious contributor to the smog problem can be reduced by recycling the exhaust gas back into the combustion chamber The general technology for its reduction has been known for many years since the exhaust gas recycling system for reducing emissions of oxides of nitrogen was developed and patented in 1955 (Tr Vol V pp 8 10 Tr Vol. XIX, p 128) In 1963 a paper written by Dr R D. Kopa of UCLA in conjunction with Messrs. Jewell and Spangler described a 60–80% reduction accomplishment in nitrogen oxide emissions Tr Vol XIX, pp 125 126)

Mr Albert Jesser, a research and mechanical engineer employed by George Cornelius at his laboratory in San Pedro, California described a device for the reduction of oxides of nitrogen developed at the Cornelius laboratory which tested well below the 350 parts per million standard established by the State of California, and reduced NOx emissions 85%. The cost of this device to the consumer is negligible (Tr Vol. XIX, pp. 129-132 Tr Vol XIX, p 128)

Mr Cornelius is a well-known inventor, formerly associated with the Holley Carburetor Company, who has done extensive work on research and development of motor vehicle air pollution control systems and devices. (Tr Vol IV, pp 51 52).

The automobile industry was notified of the existence of the Cornelius device in the latter part of 1960 (Tr. Vol. XIX, p. 134), yet none of the companies took any particular interest in the device, and the impression Jesser had of the Ford attitude toward his device was that "this is a sort of nuisance" (Tr Vol. XIX, p. 148). There were no tangible offers or responses from any automobile manufacturer. (Tr. Vol. XIX, p. 141).

Robert Van Derveer of American Motors testified on June 29, 1967 that none of the automobile manufacturers have come up with a device or system to control the emissions of oxides of nitrogen. (Tr. Vol. XXXXVI, p. 34)

DIESEL ENGINES

Contrary to popular belief, dierel engines do not emit hydrocarbons or carbon monoxide as do gasoline engines; they do, however, emit irritating smoke and odor Here again, only lip service was given to correcting the problem.

In a statement made before the Muskie Committee (GJ Ex. 429, at p 931), Dr. P. H Schweitzer of Schweitzer & Hussmann, State College, Pa a recognized authority on diesels, said in part.

"I shall not absolve the diesel engine of its polluting effect. I have raised my voice repeatedly in the past against diesel exhaust smoke and odor. In September 1954, at the fifth international symposium on combustion, in Pittsburgh, Pa., I said:

"'Even enlightened self-interest should induce the industry to take this matter [noise, smoke, and odor] seriously, more seriously than it has in the past It is easy to predict that government—State or municipal—will soon act if we do nothing about it. An incensed public may force legislators to enact unwise laws to the detriment of all of us.'

"The Automobile Manufacturers Association, which received a copy of my talk, took my advice to heart and formed a task force on diesel emissions. When? Ten years later, in March 1964."

Our expert, Wallace Linville, testified as follows on this problem:

"Q Can you tell us of any other methods which could have been used since 1955 to reduce smoke and odors?

"A There are several. Lubribol has to do largely with the control of smoke. It is a fuel additive and very adequate for the control of smoke. It has very little effect on odor The fumigation I described a few days ago is a means of getting better combustion in the combustion chamber of the diesel engine and this is utilized in controlling both smoke and odor, and the first paper that was written on this by Mr. Schweitzer was in 1957 entitled "Fumigation Kills Smoke" Mr. Schweitzer was with the Penn State University at that time." (Tr. Vol. XXXXVII, p. 7).

No manufacturers of diesel engines have utilized Lubrizol or other types of afterburners satisfactory in both smoke and other control, except from the economic standpoint (Tr Vol. XXXXVII, pp. 8–11)

OTHER APPROACHES

Reliance on the agreement not to compete in the research, development, manufacture and installation of air pollution control equipment apparently enabled the automobile manufacturers to disregard several other approaches to the problem, thus further delaying its solution.

For instance, in the late 1950's Ralph Heintz, inventor, developed and patened a stratified charge engine (Tr. Vol. VIII, pp. 10, 12, 25–27) which reduced hydrocarbon, carbon monoxide, and oxides of nitrogen emissions, while at the same time effecting a savings in gasoline consumption (Tr. Vol. VIII, pp. 22–25) Moreover, the stratified charge engine would replace the conventional engine with little or no additional cost to the consumer (Tr Vol. VIII, pp. 27–29) The development of this engine was publicized generally so that the automobile manufacturers knew of its existence and what it would do (Tr. Vol. VIII, pp. 13–18, 30-31) In fact, Victor G Raviole, former executive director of the Ford engineering staff, stated on several occasions in the early 1960's that the major automobile companies were investigating such an engine and on one occasion predicted that it might be ready for production before 1965 Tr. Vol. VIII, pp 29 30, 33; GJ Ex. 607) However, the automobile manufacturers have evidenced little faith in this approach and no such engine has been produced by any of them (Tr. Vol VIII, pp 16, 33–35, 36-39; Tr. Vol. XXXI, pp. 166-168; Tr. Vol. XXXII, pp. 150–160; Tr. Vol. XXXV, pp. 158 159).

Similarly, George Cornelius has developed and patented a direct flame afterburner and an exhaust recycling unit which have proven effective in reducing hydrocarbons, carbon monoxide, and oxides of nitrogen (Tr Vol. IV, pp 61–64, 77–79; Tr. Vol. XIX, pp 130–131) A test by Scott Laboratories shows that with this afterburner hydrocarbons were reduced to 28 ppm and carbon monoxide to 0.95% from 620 ppm hydrocarbons and 4 85% carbon monoxide (GJ Ex. 62). Mr. Cornelius estimated that, if produced in large volume, the combined package (afterburner and recycling devices) would cost the motor vehicle manufacturers about $25 to put on new cars (Tr Vol. IV, p. 92). However, the major automobile companies have exhibited little or no interest in these devices for controlling automotive pollution (Tr. Vol. IV, p 57; Tr. Vol. XIX, pp 132, 134, 141–142, 151). In fact, at a meeting in December, 1963, William Gay, Executive Engineer, Engine and Foundry Division, Ford Motor Company, told Albert Jesser, an employee of Cornelius, that "[i]f General Motors and Chrysler do not control their exhaust, we can do nothing and be competitive" (Tr. Vol. XIX, p. 148). Mr. Gay also stated that if the entire package would cost more than $5, Ford would not be interested (Tr. Vol. XIX, also at p. 148).

Several other approaches to the automotive pollutant emissions problem have apparently received little interest from the automotive manufacturers. Phillip S. Osborne of Raymond G. Osborne Laboratories developed and patented in the early 1950's a preinduction smog control concept which effectively reduced hydrocarbons, carbon monoxide, and oxides of nitrogen (Tr. Vol. XI, p. 20) The estimated manufacturing cost of the Osborne device was about $15. (Tr. Vol XI, p. 39). Again, the automobile manufacturers exhibited little interest in this approach (Tr. Vol. XI, p. 31; Tr. Vol. XII, pp. 14, 16, 24), and what interest was shown by the Ford Motor Company was coupled with indications that Ford would try to circumvent Osborne's proprietary position if the concept proved effective (Tr. Vol. XI, pp. 28–31; Tr. Vol. XII, pp. 10, 21).

Mr. Leslie Fox of S–C Carburetor, Inc. developed and patented in the late 1950's and early '60's a unique carburetor which effectively reduced hydrocarbons, carbon monoxide, and oxides of nitrogen while also eliminating evaporative losses, at a manufacturer's cost of about $6. (Tr. Vol. XXXIV, pp. 7-9, 13–14, 19). The automobile manufacturers have shown little or no interest in this device (Tr Vol XXXIV, pp 16, 21–22).

In sum, although various approaches to the motor vehicle pollutant emissions problem have shown considerable promise, the automobile companies apparently have done little with them. It seems likely that the reason for this attitude is the fact that the AMA cross-licensing agreement placed the automobile producers in a position where they did not have to fear that a competitor would develop an effective device or system for its exclusive use which might become required equipment and thus put the others at a competitive disadvantage.

BOYCOTT

As to the alleged agreement not to purchase or utilize any device developed by a non-signatory to the cross-licensing agreement:

The automobile companies, through AMA, announced in March, 1964 that a target date had been set for the installation of pollution control devices on 1967 model automobiles The MVPCB of California then approved four devices developed by independent manufacturers (American Machine and Foundry Company—Chromalloy; Universal Oil Products—Arvin Industries; W R Grace & Company—Norris-Thermador Corporation, American Cyanamid Company—Walker Manufacturing Company) which, under California law, made the installation of pollution control equipment mandatory on 1966 production. Instead of utilizing any of the approved devices, all auto companies utilized devices or systems which they themselves developed.

Dr. Askew, a member of the MVPCB since its inception, testified that the systems utilized by the industry in 1966 and 1967 did a better job than the catalytic devices approved by the board. He stated further that while the board was not satisfied with these catalytic devices, it approved them and thereby forced the industry to put on its own systems. Thus the California board's approval of these devices was calculated to and did put pressure on Detroit in order to force them to install pollution control equipment. (Tr. Vol. XXXVIII, pp. 16-17).

While it is true that all of the automobile companies used systems developed by themselves, we do not think that any inference of a boycott can be drawn from this circumstance. From the standpoint of simplicity and performance these systems at least compare favorably with the devices developed by independent manufacturers From the standpoint of cost, too, these internally developed systems compare favorably. (Fisher, Tr. Vol. XXXXIV, p. 44) Even assuming that testimony could be developed which would justify a conclusion that the independent devices were better (and cheaper) than the systems utilized, we still believe we would need more direct evidence of an agreement among the auto companies to establish a boycott.

Nor do we believe that the evidence warrants the conclusion that the independent device manufacturers did not know long before the middle of 1964 that the auto companies possessed capability to solve the problem. AMF-Chromalloy developed perhaps the best of the four independent devices mentioned above In a letter to the MVPCB dated October 29, 1964, Lipchik of Chromalloy stated that the auto companies "have no intention of using the AMF Chromalloy device" or any of the other independent devices approved by the board (Tr Vol. XVI, pp 84–85)

This conclusion was based on reports received from his men in the field. The specific conversation with an industry representative upon which this statement is most likely based took place on June 24, 1964 between Chandler of Ford and Ulyate of AMF.

Ulyate testified in this regard as follows:

"A I felt that he said in general Ford would not use anybody's device, particularly ours" (Tr Vol XIII, p 58).

Although Ulyate does not recall Chandler saying so, he received the impression from Chandler that neither Ford nor any other company would buy the AMF device (Tr. Vol. XVI, p 125).

This impression was strengthened by other observations contained in a trip report Ulyate made to Lipchik after a June 24-27, 1964 visit to Detroit, which reads in pertinent part as follows

"In general Ford personnel not very receptive to device concept They indicated that they doubted any device would ever be installed on a Ford car

"My impression was that they were just going through the motions in even considering an evaluation. With their attitude, I don't see how they can give a fair evaluation to the burner" (GJ Ex 171)

Mr Van Derveer testified, however, that American Motors was seriously considering using the AMF device (Tr Vol. XVI, p 116), but that it could not have been engineered into American's production in 1966. (Tr. Vol. XXXXVI, p. 133) After an extensive evaluation, Van Derveer stated, AMF "fell flat on their face" (Tr Vol. XXXXV, p 154) Van Derveer also testified that after an evaluation of the Norris and Walker devices it was determined that they were inadequate for American Motors 1966 needs. (Tr Vol. XXXXV, pp 154–155) As to the last of the four approved devices, Van Derveer testified that UOP would not "have any part of" American Motors (Tr. Vol XXXXV, p 155)

Ervin C. Lentz, Manager, Advanced Development and Smog Engineering, Walker Manufacturing Company, testified that as far back as 1960 the automobile companies made it clear that they were interested primarily in their own systems; that the only time they would utilize an independent device was if either their own systems would not work or if the independent device was better or cheaper. Lentz further testified that it was the hope of manufacturing a better and cheaper device that kept Walker working in the air pollution control field, so as not to lose its position as a supplier of mufflers to the automobile industry. (Tr. Vol XXVI, p. 93).

Ward B Sanford, Manager Ceramics Project, 3M Company, testified that his company was told by General Motors in early 1962 that the engine modification approach was more practical and a better potential answer to the emissions problem than were the so-called tack on devices (Tr Vol. XIX, pp 67–68).

Grand Jury Exhibit Number 421, dated April 25, 1960, a TRW document, which reads in pertinent part as follows, throws further light on GM's attitude "The job of emission should eventually be controlled in the engine, and some engines are nearly good enough now"

Grand Jury Exhibit Number 423, dated June 9, 1961, a TRW document, also states in pertinent part as follows:

"Chayne of General Motors has informed Mr Riley that their attempts to solve the problem in a different way probably at the engine, have had considerable success, and they expect this work to be completed in a month or so, and would inform TRW of the results at the proper time Ergo, General Motors is not very interested in regenerative direct flame afterburners"

In September, 1963 Chrysler told AMF that its Cleaner-Air-Package would solve the problem for them (Tr Vol XVI, p 62). Chrysler even submitted its CAP to the MVPCB for approval in July, 1963 Approval of the CAP system was not, however, forthcoming from the board until late in November, 1964

The underscored portion of the following quotation indicates that as of March 9, 1964, AMA felt that the catalytic devices approved by the MVPCB would not be used by the automobile manufacturers Grand Jury Exhibit 402, an AMA document quoted in part, supra, at p. 42, states further in pertinent part as follows.

"It would be very much to our advantage to avoid this topic—shrug it off or ignore it—for a month or two *In the interim a lot of things might change in the picture, including even the withdrawal of the catalytic devices now on tests when the submittors analyze the future possibilities for themselves.*" (Emphasis added)

It is apparent, also, that AMA's activities were designed to discourage independent manufacturers from proceeding with certification, as is evidenced by the reaction of persons connected with independent concerns In a report dated May 26, 1964 Mr D A Hirschler of the Ethyl Corporation wrote as follows concerning his contacts with AMA

"With the present likelihood that competitive exhaust devices may be approved in June and our own device late in 1964, all of the automobile manufacturers are making major efforts to find alternate mechanical routes to emission reduction for use in 1967 models, to forestall the mandatory use of the approved exhaust devices The current thinking is that with this work in progress, no manufacturer of an approved device is likely to make his device available for a possible one-year market on 1966 models" (GJ Ex 223).

Grand Jury Exhibit Number 416, dated May 21, 1959, a TRW, Inc. document also quoted in part, *supra*, at p 46, states further in pertinent part as follows

"Mr Chandler asked that he be given some time in which to explore this subject among the AMA. He explained that the smog working group, of which he is Vice Chairman, reports directly to the Board of the AMA, which includes Mr Ford, Mr. Curtice and Mr. Colbert among its members He implied that few people in the automobile industry appreciated the problem One function of the AMA working group, he said, had been to 'contain' the problem. His own view was that the smog problem is not bad enough to warrant the enormous cost and administrative problems of installing three-million afterburners."

Dr Stuart L. Ridgway, formerly senior staff member of the research laboratory of Ramo-Woolridge, a division of TRW, Inc, characterized Chandler's attitude as one seeking to delay the development and installation of anti-smog devices (Tr Vol. XXIV, p. 74). Ridgway further testified that the automobile companies acted "in concert." "They acted together and they were all working the same way" (Tr Vol XXIV, p. 76).

Ridgway's further testimony was as follows

"A. What I can distill from a collection of instances, no single one of which I can refer to, was that they were cooperative in making sure that no device was forced upon the automobile industry that would compromise the vehicle This is the language; this is their position. In other words, they would like to see the problem go away and they stated again and again in all these discussions if there was a device and it was cheap enough and it didn't compromise the vehicle in any way and had no hazards they would be right up front, but what they had done collectively, you know, was to organize to make sure that all of these criteria, performance, of no compromise to the vehicle, of safety, any reasonable critera that could be put up, cost, these barriers they were cooperating in They were acting in concert. They made organizations whose purpose was to do these things. They spent money, lots and lots of money on instrumentation, on test tracks, on environmental places, dynamometers, to see whether the afterburner would work when the temperature was 120 degrees Fahrenheit in a driving rainstorm" (Tr Vol XXIV, p 77)

Ridgway also testified as follows on the meaning of "contain" the problem as attributed to Mr Chandler

"A Well, no, I got the—the attitude was ... here was an attitude I don't know whether it was wholly Chandler's, but between Chandler and Gay they said that they spent lots and lots of money in the development of deceleration devices, because it was believed that deceleration was 'the' problem

"And so, everybody had a deceleration device, and, lo and behold, it turns out that deceleration wasn't the problem ... they had spent all this money for nothing

"So, therefore, they had been burned And they were going to make absolutely sure first, that the problem was really well understood, and that no device that would cause any detriment to the performance of the car or anything, would be forced down their throats.

"So, it was clear that, from their point of view, this thing was a defensive organization" (Tr Vol XXIII, p 24)

As to an agreement among the signatories to the cross-licensing agreement to eliminate the competition of third parties in the development of motor vehicle air pollution control equipment, the evidence is as follows

Dr. Ridgway testified that Woodrow F Gaines, also a TRW employee, told him that a Ford executive (Gaines' stepfather) reported that GM had, in 1961, increased its valve purchases from TRW by 25% in return for TRW going "slow" on development of its pollution control device (Tr Vol XXIII, pp 50–56, Tr. Vol XXIV, p. 327) Mr Gaines, now employed by the Missile Division, Chrysler Corporation, testified that the source of this report was another TRW employee, a technician in the automotive research lab, whose name he could not recall, and that he was not a Ford executive[10] (Tr Vol. XXXIII, pp. 13–15) He also testified that as the story originally came to him, the increase in orders was for pistons not valves, and the increase was in payment of patent rights purchased by GM from TRW (Tr Vol. XXXIII, pp. 10–11).

In response to our additional subpoena duces *tecum*, TRW supplied us with the numbers of units and dollar amounts of sales to GM for valves and pistons for the years 1959, 1960, and 1961 Taking 1959 as the base year, GM's valve purchases from TRW increased by approximately 19% in 1960, and declined by a minimal amount in 1961 In 1959, GM purchased no pistons from TRW In 1960, GM purchased $8,540 worth In 1961 the amount purchased was $250,321 Total industry passenger car sales in the United States in 1960 were approximately 19% ahead of 1959 sales, and 1961 sales were a minimal amount below the 1959 sales It is apparent that the GM increase in valve purchases from TRW in 1960 can rationally be accounted for by a rising sales increase It is further apparent that the 1961 valve purchases followed industry sales closely At the same time, from 1959 to 1961, GM's share of the market increased from 45.7% to 49.3% One might even have expected that valve purchases from TRW would have increased As for the increase in piston sales by TRW to GM in 1961, the total sales figure of $250,321 seems much too low a "compensation" for TRW to go slow on a program in which they had spent approximately $1 million.

Additional witnesses from TRW were called before the grand jury but shed no light on any pressures applied to TRW by automobile companies in this field which are based upon TRW's position as a supplier of products to the automobile industry Thus we have not developed evidence that any signatory to the cross-licensing agreement at-

Footnotes at end of article

tempted in any way to interfere with the efforts of any of the four independent device manufacturers in developing pollution control equipment, whether or not such persons were suppliers of products to the automobile industry. Moreover, the evidence does not show that the industry announcement of the 1967 target date and subsequent utilization of their own systems on 1966 models was a concerted effort by them to boycott the devices approved by the MVPCB of California.

As a matter of fact, continued work in the air pollution control equipment field by outside concerns has been prompted by encouragement from the automobile industry. Mr. M. P. Venema, President and Chairman of the Board of Directors of Universal Oil Products Company, (UOP), testified that General Motors told them that they will need a device in addition to their air injection systems in order to meet future criteria. (Tr. Vol. XXXIX, p. 44). UOP is now supplying GM with catalysts. (Tr. Vol. XXXIX, p. 43). Venema stated that the industry's attitude is much better today than it was years ago in that the industry now feels it can gain from outsiders as compared to "their feeling a few years back that the outsiders were more intruders than helpers." (Tr. Vol. XXXIX, p. 43).

With respect to various aspects of the entire situation under investigation here, some significant admissions by John D. Caplan, head of the Fuels and Lubricants Department, General Motors Corporation, and former Chairman of the VCP, are contained in Grand Jury Exhibit Number 491, dated December 9, 1966. Mr. Caplan's remarks are in response to a request by Louis C. Lundstrom, Director, Automotive Safety Engineering, GM, for Caplan's review of and comments on Chapter 4 of the book entitled "Unsafe at Any Speed" by Ralph Nader. Chapter 4 deals with the subject "The Power to Pollute." Caplan prefaced his specific comments by stating that "you will note that I have not limited my review only to criticisms of the chapter but have also acknowledged areas wherein Nader's comments may be valid." (Tr. Vol. XXXV, p. 56; GJ Ex 491). Referring to specific pages of the book, Caplan made *inter alia* the following comments:

Page 101: "(a) The million dollar a year industry expenditure cited on this page is optimistically high for the 1953 era. . . . (GJ Ex 491, p. 3; Tr. Vol. XXXV, p. 63)."

Page 105: "Nader's statement that the California MVPCB action in certifying the four devices 'moved' the automobile industry management to up the target date from the 1967 to the 1966 model year appears valid. However, he fails to point out that this could be done only after the MVPCB cooperated to the extent of allowing exemptions for the 1966 model year on many engine-transmission combinations." [11] (GJ Ex. 491, pp. 3–4; Tr Vol. XXV, p. 56).

Page 106: "(a) The comment that the industry was guilty of 'only speaking with one voice' in the automotive air pollution area is true. Although individual company technical personnel were allowed to present 'company' technical papers, essentially all other types of pronouncements emanated only from AMA statements." (GJ Ex 491, p. 4; Tr. Vol. XXXV, p. 56).

Page 107. "Mr. Nader's remarks concerning the basic issue (paragraph 3) appear to be the crux of this chapter. His criticism of the lack of recognition of the problem and lack of work on the problem by the industry is easily refuted. Where we must give the 'devil his due' is in the area of implementation of our findings. Does such implementation occur only in response to legislative pressure and public criticism? Development of material to refute this criticism is difficult." (GJ Ex 491, p. 4; Tr. Vol. XXV, p. 57).

FOOTNOTES

[1] Mountains surround the Los Angeles basin on three sides with but one outlet to the ocean. This basin also has a unique condition called temperature inversion. Ordinarily the air becomes cooler the higher it rises. In the Los Angeles area, during inversion periods, the polluted air is trapped beneath an invisible ceiling of warmer air thus preventing the normal upward flow of air pollutants to a level where it would be dissipated or diluted. Thus a concentration of air pollutants occurs to varying degrees, depending upon the height of the inversion lid. Too, in this area, weak winds prevail which at times stagnate completely, lacking the velocity to blow the pollution rapidly out of the basin, thus giving the abundant sunshine of southern California ample time to produce the photochemical reactions between the pollutants more fully defined herein as "smog."

[2] Los Angeles County has the highest registration of cars per person (2.3 persons/car) of any county in the United States.

[3] As late as July 30, 1963 Motor Vehicle Pollution Control Board (MVPCB) officials visiting Detroit were told: "based on the time that it takes to develop any new innovation in motor car design, the solution of the smog problem by the automobile industry was probably 7 to 10 years away . . ." (Tr. Vol. XXXVIII, pp. 7–9; GJ Ex 227). As hereinafter shown, the industry was able to and did install exhaust systems or devices in late 1965 on 1966 models when forced to do so.

[4] AMA now employs a full-time president. (Tr. Vol. XVIII, pp 54–55; GJ Ex. 300).

[5] The cross-licensing agreement provides as follows:

"ARTICLE V—EXCHANGE OF TECHNICAL DATA AND INFORMATION

"Each of the parties hereto further agrees to exchange through its authorized representative with representatives of the remaining parties hereto all technical data and other information pertaining to said Licensed Devices. Such exchange of technical data and other information shall be conducted under the direction of the Vehicle Combustion Products Subcommittee of the Engineering Advisory Committee of the Automobile Manufacturers Association." (GJ Ex. 263, 264, 265, and 266).

[6] The significance of the AMA Suggestion Submission Agreement is illustrated by the following pertinent excerpt from a letter of October 7, 1960 written by R. H. Isbrandt, Director, Automotive Engineering, American Motors Corporation:

As explained in our meeting on September 21st, the automotive companies, working through the Automobile Manufacturers Association, have agreed that the treatment of exhaust gas is an industry problem which will be handled on a cooperative basis. The A.M.A Submission Agreement was developed to be used by all automobile comapnies in evaluating exhaust devices which are submitted for test. This assures that there will be an interchange of information between the automobile companies and that no one company will attempt to take competitive advantage of any solution which is developed in our current test program. For this reason we have requested that you sign the A M A Submission Agreement. Other suppliers, including chemical manufacturers have signed this agreement recognizing that there is no desire on the part of any automobile company to do anything that would be detrimental to any supplier who can come up with a solution to this problem." (GJ Ex. 534).

[7] When an attempt was made in 1963 to broaden the scope of the cross-licensing agreement "to overcome the restrictions that are currently preventing adequate discussion of technical steps that will lead to solutions" (GJ Ex 305) the attempt was defeated by the opposition of GM. This is explained in a GM internal communication from H. F. Barr, its member on the EAC, dated May 6, 1965, "Subject: G.M. Policy on A.M.A. Vehicle Combustion Products Com. Work" as follows:

"2. In an endeavor to permit technical discussion, the Engineering Advisory Committee of A.M.A. asked the A.M.A. Patent Committee to propose broader language for the agreement.

* * * * *

"3. In subsequent review of this proposed action for the A.M.A. Board of Directors, in our Engineering Policy Group meeting of March 20, 1963, our management reaffirmed that the A.M.A. agreement should not be changed in this way. On April 30, the E.A.C. further discussed this proposal, with G.M. being the only member opposed to extending the agreement to other areas.

"4. The basic trouble with this problem is the involvement of (1) an established cross licensing agreement for hardware now established, with (2) a need for technical discussion and exchange of information in broader areas. We feel that these are two separate items and need not be combined in a new, broader cross licensing agreement for non existent hardware." (GJ Ex. 325).

[8] The fact that on occasions the pcv was offered as optional equipment indicates the ability to supply this air pollution control equipment, yet the auto manufacturers did not install them on all models quite evidently because of the agreement previously referred to.

[9] This illustrates that bar an agreement, competition to research, develop and manufacture pollution control devices would stimulate and compel rather than delay the installation of devices by all companies. (Tr. Vol. XXX, p. 147).

[10] The testimony was that this technician was known as "Olie." We called a TRW official named Ohly as a witness, but ascertained that he was not the person involved. We have learned since the last grand jury session that the person involved is Merle E. Olson of Chesterland, Ohio. From our experience in this matter, however, we doubt that his testimony will be helpful.

[11] California State regulations permitted only 2% exemptions. At most less than 4% were exempted (Askew, Tr. Vol. XXXVIII, p. 22).

CONSENT DECREE

/ BERNARD M. HOLLANDER, ALLEN E. MCALLESTER, RAYMOND W. PHILIPPS, DEPARTMENT OF JUSTICE, ANTITRUST DIVISION, 1307 U.S. COURT HOUSE, LOS ANGELES, CALIFORNIA 90012, TELEPHONE: 688-2500.

U.S. DISTRICT COURT CENTRAL DISTRICT OF CALIFORNIA

(Civil Action No. 69-75-JWC—Filed: September 11, 1969 (Final Judgment Entered 10/29/69))

UNITED STATES OF AMERICA, PLAINTIFF,

v.

AUTOMOBILE MANUFACTURERS ASSOCIATION, INC; GENERAL MOTORS CORPORATION; FORD MOTOR COMPANY; CHRYSLER CORPORATION; AND AMERICAN MOTORS CORPORATION, DEFENDANTS.

STIPULATION FOR ENTRY OF CONSENT JUDGMENT

It is stipulated by and between the undersigned parties, by their respective attorneys, that:

(1) The parties consent that a Final Judgment in the form hereto attached may be filed and entered by the Court at any time after the expiration of thirty (30) days following the date of filing of this Stipulation without further notice to any party or other proceedings, either upon the motion of any party or upon the Court's own motion, provided that plaintiff has not withdrawn its consent as provided herein;

(2) The plaintiff may withdraw its consent hereto at any time within said period of thirty (30) days by serving notice thereof upon the other parties hereto and filing said notice with the Court;

(3) In the event plaintiff withdraws its consent hereto, this Stipulation shall be of no effect whatever in this or any other proceeding and the making of this Stipulation shall not in any manner prejudice any consenting party in any subsequent proceedings.

U.S. DISTRICT COURT CENTRAL DISTRICT OF CALIFORNIA

(Civil Action No. 69-75-JWC—Entered: October 29, 1969)

UNITED STATES OF AMERICA, PLAINTIFF,

v.

AUTOMOBILE MANUFACTURERS ASSOCIATION, INC.; GENERAL MOTORS CORPORATION; FORD MOTOR COMPANY; CHRYSLER CORPORATION; AND AMERICAN MOTORS CORPORATION, DEFENDANTS

FINAL JUDGMENT

The plaintiff, United States of America, having filed its complaint herein on January 10, 1969, and the plaintiff and the defendants by their respective attorneys having severally consented to the entry of this Final Judgment without trial or adjudication of or finding on any issues of fact or law herein and without this Final Judgment constituting evidence or an admission by any of them in respect to any such issue;

Now, Therefore, before any testimony has been taken and without trial or adjudication of or finding on any issue of fact or law herein, and upon consent of the parties as aforesaid, it is hereby

Ordered, adjudged and decreed as follows:

This Court has jurisdiction of the subject matter herein and of the parties hereto. The complaint states a claim upon which relief may be granted against the defendants under Section 1 of the Act of Congress of July 2, 1890, entitled "An Act to protect trade and commerce against unlawful restraints and monopolies," commonly known as the Sherman Antitrust Act, as amended.

II

As used in this Final Judgment:

(A) "Devices" means air pollution emission control designs, devices, equipment, methods, or parts thereof, for motor vehicles.

(B) "Restricted information" means all unpublished information of the type usually classified as company confidential concerning applied as distinguished from basic research in, or concerning the development, innovation, manufacture, use, sale or installation of Devices. It includes trade secrets, unpublished company policy, and other unpublished technical information for developing, making, improving, or lowering the cost of, Devices by a motor vehicle manufacturer. "Restricted information" shall not mean (i) information concerning basic research in gaining a fuller knowledge or understanding of the presence, nature, amount, causes, sources, effects or theories of control of motor vehicle emissions in the atmosphere, or (ii) information relating primarily to equipment, methods or procedures for the testing or measurement of Devices, or (iii) information for or resulting from the testing or measurement of production prototypes of Devices of an advanced stage exchanged solely for such purposes. Information shall be deemed to be published when it is disclosed without restriction to the public, or to media of general circulation, or to the trade press, or to meetings of stockholders, dealers, or financial analysts, or to meetings of professional, scientific or engineering societies, or committees thereof, the membership of which is not limited to persons employed by defendants or by motor vehicle manufacturers, or to meetings called by representatives of Federal, state or local governments or agencies authorized to issue motor vehicle emission control regulations.

III

The provisions of this Final Judgment shall be binding upon each defendant and upon each of its subsidiaries, officers, directors, agents, servants, employees, successors and assigns, and upon all other persons in active concert or participation with any of them who shall have received actual notice of this Final Judgment by personal service or otherwise, but shall not apply to any transaction between or among a parent company, its subsidiaries, officers, directors, agents, servants and/or employees. Nothing in this Final Judgment shall have any effect with respect to any activities outside the United States which do not adversely and substantially affect the foreign commerce of the United States.

IV

(A) Each defendant is enjoined and restrained from:

(1) Combining or conspiring to prevent, restrained or limit the development, manufacture, installation, distribution or sale of Devices;

(2) Entering into, adhering to, enforcing or claiming any rights under any provisions of any agreement, arrangement, understanding, plan or program (hereinafter "agreement") with any other defendant or manufacturer of motor vehicles or Devices:

(a) to exchange restricted information;

(b) to cross-license patents or patent rights on Devices which cross-license includes patents or patent rights acquired subsequent to the date of any such cross-license;

(c) to delay installation of Devices or otherwise restrain individual decisions as to installation dates;

(d) to restrict publicity of research and development relating to Devices;

(e) to employ joint assessment of the value of patents or patent rights of any third party relating to Devices;

(f) to require that acquisition of patent rights relating to Devices be conditioned upon availability of such rights to others upon a most-favored-purchaser basis;

(g) to file, in the absence of a written authorization for a joint statement by the agency involved, with any governmental regulatory agency in the United States authorized to issue emission standards or regulations for new motor vehicles or Federal motor vehicle safety standards or regulations, any joint statement regarding such standards or regulations except joint statements relating to (i) the authority of the agency involved, (ii) the draftmanship of or the scientific need for standards or regulations, (iii) test procedures or test data relevant to standards or regulations, or (iv) the general engineering requirements of standards or regulations based upon publicly available information; provided that no joint statement shall be filed which discusses the ability of one or more defendants to comply with a particular standard or regulation or to do so by a particular time, in the absence of a written agency authorization for such a joint statement, and provided also that any defendant joining in a joint statement shall also file a statement individually upon written request by the agency involved; or

(h) not to file individual statements with any governmental regulatory agency in the United States authorized to issue emission standards or regulations for new motor vehicles or Federal motor vehicle safety standards or regulations.

(B) Nothing in this Final Judgment shall prohibit any defendant:

(1) from furnishing or acquiring any restricted information for the defense or prosecution of any litigation or claim;

(2) from entering into or performing under any otherwise lawful agreement with any other person or conducting *bona fide* negotiations looking to any such agreement:

(a) for the purchase or sale of specific commercial products;

(b) for the license of specific existing patent rights or from including in any such agreement provision for a nonexclusive grant-back of patent rights on improvements obtained by the licensee during the term of the license or a reasonable period thereafter; or

(c) for the purchase, sale or license of specific existing restricted information or specific engineering services relating to Devices or from including in any such agreement provision for a nonexclusive grant-back of patent rights on improvements obtained by the licensee during the term of the license or a reasonable period thereafter;

or from furnishing or acquiring any restricted information directly relating thereto:

(3) from entering into, renewing or performing under any otherwise lawful agreement with any nondefendant person, firm or corporation that does not account for more than 2% of world production of motor vehicle passenger car, truck and bus units in the calendar year preceding the entering into or renewing such agreement (See Appendix A); or

(4) from entering into, renewing or performing under any agreement which is submitted in writing to the plaintiff and to which plaintiff consents in writing.

(C) Nothing in Section IV(A)(2)(a) shall prohibit any defendant from engaging in any activity outside the United States reasonably necessary:

(1) to the development of, response to, or compliance with existing or proposed vehicle emission laws, regulations or standards of a foreign governmental body, or

(2) to the performance under any otherwise lawful agreement for the production of motor vehicles outside the United States with any person, firm or corporation not engaged in the production of motor vehicles in the United States at the time of entering into or renewing such agreement.

V

(A) Each manufacturing defendant is ordered and directed to exercise its right to withdraw from the AMA cross-licensing agreement of July 1, 1955, as amended, and to take such steps as are necessary to accomplish said withdrawal within one hundred twenty (120) days from the date of entry of this Final Judgment. Notwithstanding such withdrawal defendants may continue to exercise those rights and claims relating to royalty-free licenses under the cross-licensing agreement which have accrued up to the date of entry of this Final Judgment.

(B) Defendant AMA is ordered and directed to relinquish its responsibilities under the AMA cross-licensing agreement of July 1, 1955, as amended, within sixty (60) days from the date of entry of this Final Judgment.

VI

(A) Upon written request therefor and subject to the conditions set forth herein:

(1) Each manufacturing defendant is ordered and directed to grant to any person to the extent that it has the power to do so a nonexclusive, nontransferable and royalty-free license to make, have made, use, lease or sell Devices under any claim of any United States patent or any United States patent application owned or controlled by said defendant or under which it has sublicensing rights, which patent was issued or application was filed prior to the date of entry of this Final Judgment and licensed under the AMA cross-licensing agreement of July 1, 1955, as amended, provided that if the manufacturing defendant is obligated to pay royalties to another on the sales of the licensee the license under this paragraph may provide for the payment of those same royalties to the defendant;

(2) Each manufacturing defendant shall grant to any licensee under (1) above, to the extent that it has the power to do so, an immunity from suit under any foreign counterpart patent or patent application for any product manufactured in the United States under the license for sale abroad or for any product manufactured abroad and sold in the United States, provided that if the manufacturing defendant is obligated to pay royalties to another on the sales of the licensee the license may provide for the payment of those same royalties to the defendant; and

(3) Defendant AMA is ordered and directed to make available for examination and copying by any person the technical reports in its possession or control prepared or exchanged by defendants pursuant to said cross-license within two years prior to the entry of this Final Judgment, which are identified in Appendix B.

(B) Any existing licensee of any manufacturing defendant shall have the right to apply for and receive a license or licenses under this Final Judgment in substitution for its existing license or licenses from any manufacturing defendant, insofar as future obligations and licenses are concerned. Any licensee shall be free to contest the validity and scope of any licensed patent.

VII

Defendant AMA is ordered and directed to mail a copy of this Final Judgment to all signatories to the AMA cross-licensing agreement of July 1, 1955, as amended, and to all known domestic manufacturers of motor vehicles and motor vehicle engines within thirty (30) days from the date of entry of this Final Judgment, and to issue a press release to the domestic trade and business press relating the substance of the Final Judgment.

VIII

For the purpose of determining or securing compliance with this Final Judgment, duly-authorized representatives of the Department of Justice shall, upon written request of the Attorney General, or the Assistant Attorney General in charge of the Antitrust Division, and on reasonable notice to any defendant made to its principal office, be permitted, subject to any legally recognized privilege, access during the office hours of said defendant to all books, ledgers, accounts, correspondence, memoranda, and other records and documents in the possession or under the control of said defendant relating to any matters contained in this Final Judgment, and subject to the reasonable convenience of said defendant and without restraint or interference from it, to interview officers or employees of said defendant, who may have counsel present, regarding any such matters. Said defendant, upon the written request of the Attorney General or the Assistant Attorney General in charge of the Antitrust Division, shall submit such written reports with respect to any of the matters contained in this Final Judgment as from time to time may be requested. No information obtained by the means provided in this Section shall be divulged by any representative of the Department of Justice to any person other than a duly authorized representative of the Executive Branch of the plaintiff, except in the course of legal proceedings to which the United States is a party for the purpose of securing compliance with this Final Judgment or as otherwise required by law.

IX

Section IV(A)(2)(a) and (g) of this Final Judgment shall expire ten years after the date of entry hereof, provided that plaintiff may apply to this Court for the continuation of one or both of said provisions, such application to be made not later than nine years after the date of entry of this Final Judgment.

X

Jurisdiction of this cause is retained for the purpose of enabling any of the parties to this Final Judgment to apply to this Court at any time for such further orders and directions as may be necessary or appropriate in relating to the construction of or carrying out of this Final Judgment, for the modification or vacating of any of the provisions thereof, and for the purpose of the enforcement of compliance therewith and the punishment of violations thereof.

Dated: October 29, 1969.

JESSE W. CURTIS,
U.S. District Judge.

Section IV(B)(3) of this judgment was prepared in reliance on the motor vehicle production statistics set forth in the following tables contained in Ward's 1969 Automotive Yearbook (31st edition) published by Powers and Company, Inc., Detroit, Michigan, at page 14:

1968 WORLD MOTOR VEHICLE PRODUCTION (20 LEADING COUNTRIES)

	Passenger cars	Trucks and buses	1968 total	1967 total
United States	8,843,031	1,950,713	10,793,744	8,992,269
Canada	900,527	277,649	1,178,176	943,992
Subtotal	9,743,558	2,228,362	11,971,920	9,936,261
Japan	2,055,821	2,030,005	4,085,826	3,146,486
West Germany	2,535,433	571,525	3,106,958	2,482,319
United Kingdom	1,815,000	409,300	2,224,300	1,937,119
France	1,833,047	242,570	2,075,617	2,009,672
Italy	1,544,933	118,716	1,633,649	1,542,669
Argentina	127,965	53,011	180,976	175,318
Australia	340,000	75,000	415,000	390,119
Austria	2,200	2,350	4,550	4,383
Brazil	158,863	118,371	277,234	225,300
India	37,000	41,000	78,000	69,000
Netherlands	60,000	7,000	67,000	56,566
Mexico	102,907	37,192	140,099	123,751
Poland	40,500	39,600	80,100	61,400
Spain	311,531	81,902	393,433	362,906
Sweden	223,330	21,361	244,691	214,560
Czechoslovakia	126,000	50,200	176,200	164,000
Yugoslavia	50,400	13,680	64,080	60,000
U.S.S.R.	250,000	550,000	800,000	728,900
Subtotal	11,614,930	4,462,783	16,077,713	13,754,468
Grand total	21,358,488	6,691,145	28,049,633	23,690,729

Note: Data for above tabulation drawn from best sources available. Statistics for some Red-bloc countries based upon monthly averages and are subject to slight change. U.S.S.R. for 1968 is an estimate based upon final 1967 counts.

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WORLD MOTOR VEHICLE PRODUCTION—1969 (26 LEADING MANUFACTURERS)

Ranking and manufacturer	Country	Cars	Trucks	Total, 1968	Total, 1967
1 GM	United States	4,592,077	828,978	5,421,055	4,798,301
2 Ford	do	2,396,924	623,272	3,020,196	2,122,841
3 Chrysler	do	1,585,591	173,769	1,759,360	1,505,561
4 Volkswagen	West Germany	1,448,533	100,400	1,548,933	1,162,258
5 Fiat	Italy	1,301,751	89,470	1,391,221	1,312,215
6 Toyota	Japan	659,189	438,216	1,097,405	832,130
7 BLM	England	807,067	179,204	986,271	646,318
8 Nissan	Japan	571,614	408,220	979,834	726,067
9 Renault	France	731,000	76,000	807,000	777,468
10 British Ford	England	553,701	108,017	661,718	526,987
11 Opel (GM)	West Germany	646,718	10,000	656,718	549,281
12 Toyo Kogyo	Japan	178,115	282,994	461,109	383,323
13 Citroen	France	383,000	77,600	460,600	500,030
14 Ford	Canada	287,286	157,815	445,101	295,779
15 GM	do	338,016	86,288	424,304	384,919
16 Peugeot	France	377,725	29,980	407,705	405,314
17 Mitsubishi	Japan	130,253	229,723	259,976	317,378
18 GM Vauxhall	England	244,918	97,222	342,140	290,706
19 Ford Cologne	West Germany	306,232	28,923	335,155	396,646
20 Honda	Japan	186,560	132,257	318,817	149,289
21 Chrysler Simca	France	317,248	0	317,248	248,574
22 Daimler-Benz	West Germany	216,000	68,837	284,837	254,138
23 AM Corp	United States	268,439	0	268,439	229,058
24 D. Kogyo	Japan	89,296	171,059	260,355	225,490
25 Chrysler	Canada	219,151	16,573	235,724	202,812
26 Chrysler Rootes	England	189,102	27,066	216,168	203,312

Note: Because both production and factory sales are used in the above tabulation, the above rankings are not absolute and could vary slightly. Data used represents vehicles produced in the indicated locations. Fiat excludes Autobianchi. Volkswagens excludes Auto-Union. BLM was formed in 1968, hence its 1967 total represents BMC.

It is contemplated by the parties that Ward's Automotive Yearbook or any successor publication will be the source of the statistics necessary to the future interpretation of the provisions of Section IV(B)(3).